

SCIENCE

NEW SERIES
VOL. LXX, No. 1802

FRIDAY, JULY 12, 1929

ANNUAL SUBSCRIPTION, \$6.00
SINGLE COPIES, 15 CTS.

LANE—ANIMAL BIOLOGY

105 Illustrations. Cloth \$3.50

By HENRY HIGGINS LANE, PH.D., *University of Kansas*

An introduction to zoology for college and university students. It presents the animal as a living organism; morphology is stressed, but the greater part of the discussion has to do with general principles.

MOTTIER—A COLLEGE TEXTBOOK OF BOTANY FOR FIRST YEAR STUDENTS

333 Illustrations. Cloth \$3.50

By DAVID MYERS MOTTIER, *Indiana University*

The text is presented in concrete form with material used in observation or in a specific type for life history study included.

CHAMBERLAIN—ORGANIC CHEMISTRY

2d Edition. Cloth \$4.00

By J. S. CHAMBERLAIN, *Mass. Agric. College*

The subject matter is presented in a sufficiently elementary manner to be well within the grasp of the student in his first course in Organic Chemistry, at the same time, it is comprehensive in that it covers the entire field by taking up practically all the important groups of compounds.

RICHTER—ORGANIC CHEMISTRY

By PROF. VICTOR VON RICHTER

Vol. I. Chemistry of the Aliphatic Series, translated and revised from the German edition by Percy E. Spielman, Ph.D., B.Sc., F.I.C., A.R.C.Sc. Cloth \$7.00.

Vol. II. The Carbocyclic Compounds, edited by Professor R. Anschütz and Doctor H. Meerwein. Translated from the German edition by E. E. Fournier D'Albe, D.Sc., A.R.C.Sc., England. Cloth \$8.00.

Vol. III. The Heterocyclic Compounds, edited by Professor R. Anschütz and Doctor H. Meerwein. Translated from the eleventh German edition by E. E. Fournier D'Albe, D.Sc., A.R.C.Sc., England. Cloth \$6.00.

These volumes present a very thorough treatment of organic chemistry.

P. BLAKISTON'S SON & CO.

Publishers

1012 Walnut St.

Philadelphia

**Glacial Land Forms as Elements in the
Scenery of the Sierra Nevada
South of Lake Tahoe**

By WELLINGTON JONES

Illustrated, 30 cents

**A Critical Analysis of the Specific Char-
acters of the Genus *Acuaria*, Nema-
todes of Birds, with descriptions
of New American Species**

By O. L. WILLIAMS

Illustrated, 50 cents

**Two New Species of the Protozoan Genus
Ephelota from Monterey Bay**

By ALDEN E. NOBLE

Illustrated, 25 cents

***Coccospira stenopelmati*
*gen. nov. sp. nov.***

**A Gregarine from *Stenopelmatus*
(Orthoptera) from Central
California**

By LESLIE M. SMITH

Illustrated, 25 cents

University of California Press

Berkeley, California



**LaMOTTE-MORGAN
SOIL TESTING SET**

This handy outfit is especially designed for rapid, accurate work in determining soil reactions. Tests can be made in from 2 to 5 minutes with an accuracy of 0.2 pH. The set covers the pH range 4.0-8.4 and this range can be extended on either end.

Complete with instructions, color chart and LaMotte Soil Handbook containing an extensive list of plants with their soil preferences.

Price \$100.00 f.o.b. Baltimore.

LaMotte Chemical Products Co.

418 Light St.

Baltimore, Md., U. S. A.



SPALTEHOLZ

Transparent

PREPARATIONS

The largest variety in America
on display in our showrooms

**Also SKELETONS
SKULLS, etc.
MODELS
CHARTS**

Selections from our large stock can be made by personal selection. We cordially invite you to call to see us. Mail inquiries and orders given prompt attention.

Catalog sent on request

CLAY-ADAMS CO.

Importers of Models, Charts, Skeletons, etc.

117 East 24th St., New York, N. Y.

SCIENCE

VOL. LXX

FRIDAY, JULY 12, 1929

No. 1802

<i>The Economic Status of Scientific Men and Women: Budget Needs of College Teachers:</i> DR. BENJAMIN R. ANDREWS	19	<i>Scientific Books:</i>	
<i>Salaries and Supplementary Earnings of College Teachers:</i> DR. FRANK P. BACHMAN	26	<i>Fowler on Statistical Mechanics:</i> PROFESSOR J. H. VAN VLECK	41
<i>Obituary:</i>		<i>Scientific Apparatus and Laboratory Methods:</i>	
<i>Professor John A. Mandel:</i> PROFESSOR W. C. MAC-TAVISH. <i>Recent Deaths</i>	29	<i>A Method for Comparing the Value of Ammonia Nitrogen and Nitrate Nitrogen:</i> DR. WILLIAM G. FRIEDEMANN. <i>A New Type of Respiration Chamber:</i> T. J. MANEY, P. L. HARDING and H. H. PLAGGE	43
<i>Scientific Events:</i>		<i>Special Articles:</i>	
<i>The Opening of Down House; The Joint Meeting of the French and British Associations at Havre; The Royal Geographical Society; The Retirement of Dean Veranus A. Moore of Cornell University; Grants-in-Aid Fund of the National Research Council</i>	30	<i>Relation of External Environment to Course of a B. enteritidis Infection in Mice:</i> DR. I. J. KLIGLER and L. OLITZKI. <i>Botanical and Geological Evidence for an Ancient Lake:</i> DR. H. R. ALDRICH and DR. N. C. FASSETT	45
<i>Scientific Notes and News</i>	32	<i>Science News</i>	x
<i>University and Educational Notes</i>	36		
<i>Discussion:</i>			
<i>Biological Control of the Prickly Pear in Madagascar:</i> DR. CHARLES F. SWINGLE. <i>Horses, Dogs and Cats:</i> AUSTIN H. CLARK. <i>Atmospheric Electricity:</i> DR. VICTOR A. ENDERSBY, PROFESSOR DUNCAN G. FOSTER. <i>Educational Science:</i> PROFESSOR SAMUEL W. FERNBERGER	37		
<i>Special Correspondence:</i>			
<i>The Recent Bone-cavern Find at Bishop's Cap, New Mexico:</i> DR. WILLIAM ALANSON BRYAN	39		

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. McKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

New York City: Grand Central Terminal

Lancaster, Pa.

Garrison, N. Y.

Annual Subscription, \$6.00.

Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

THE ECONOMIC STATUS OF SCIENTIFIC MEN AND WOMEN¹

BUDGET NEEDS OF COLLEGE TEACHERS

By Dr. BENJAMIN R. ANDREWS

PROFESSOR OF EDUCATION, TEACHERS COLLEGE, COLUMBIA UNIVERSITY

THE teacher has three groups of personal budget needs: those connected with his profession; those concerned with living expenses of self and family, and those necessary for financial security. Every one must meet his living expenses; every one who spends intelligently tries to provide for financial security; but professional needs represent items that do not appear in the average person's budget. The teacher who does research as well as teaching must keep in close touch with the progress of his subject and his profession, and this involves annual expenses that every teacher knows. He must also be adding to his subject by his own studies and research, and

part of their cost with many workers comes back upon the private purse. He must also have a broad mental equipment and the personal and social resources of the traditional college teacher who deals with youth and desires to serve any intellectual or personal need that arises. Since the college teacher is responsible for the increase and dissemination of the knowledge necessary for civilization and for progress, society is concerned that he have personal income adequate to his function and that he administer his funds so as to function efficiently. In his professional expenditures the teacher is a public person, and even his private living conditions and his security are of public concern as far as they affect his work as teacher and researcher.

¹ Symposium of invited papers read before a general session of the American Association for the Advancement of Science, New York, December 28, 1928.

This paper discusses a few aspects of personal expenditure of college teachers, illustrating them by returns from a schedule of inquiry answered by sixty-four teachers in a metropolitan professional school referred to herein as the first group¹ and by forty-six teachers in three institutions, located in small eastern cities, referred to as the second group. Appreciation is expressed for the contributions of these correspondents which while not adequate for reliable generalizations have helped clarify the problems of spending.

PROFESSIONAL NEEDS

The college teacher must keep in contact with his field through association memberships, professional meetings, books and journals, and must budget accordingly.

Professional contacts with fellow workers have their peculiarly stimulating value. There is creative power for new ideas in conventions, and in meetings of research committees. There is profound truth for scientific progress in the familiar valuation that the talk in the hotel lobby at a convention is as valuable as the papers read at the sessions. Who draw benefits from such contacts? The young worker surely who meets leaders and who can thereafter attach a face and a personality to what has been so far a mere name, and who may at a convention make an acquaintance on which his whole career may turn. But also the convention has unique values for the mature worker who meets his peers, gets orientated on new research and makes living contact with the movements of thought in his specialty. That man-to-man meeting with time for discussion is prized, is indicated by one correspondent who craves for travel to visit laboratories in other universities, stating that conventions do not meet his needs of protracted and intimate contacts with a limited few. The recent development of committees, councils, boards in specialized fields of research, concerns this need, and ten of the first group furnishing data had personal expenditures last year for committee work.

Membership in professional organizations is prized for these personal contacts, for association journals and printed proceedings and for participation in organized research. Support of such organizations is part of the scholar's faith. The first group of college teachers belong to from one to twelve professional organizations, and the second group from none to seven organizations, with the medians at five and three memberships respectively, and with attendance during the year upon a median of two and one out-of-town meetings respectively. The first group illus-

trates the gradation in such matters by academic rank; instructors belong to a median of two organizations and attend one meeting; assistant professors belong to three organizations and attend two meetings; associate professors belong to five organizations and attend two meetings, and for professors these numbers are six to seven and three. Here then is one formula of academic ascension—memberships and meetings in ratios 2-1; 3-2; 5-2, and 7-3.

Professional Journals: From one to twenty professional journals are taken by these college teachers, with a median of four to five taken by members of the first group and of three in the second group. The number taken increases with rank from a median of three to four for instructors to eight for professors in the first group. Is the present supply of journals adequate for these teachers' needs? Only twenty-three of fifty-three in the first group and fifteen of thirty-nine in the second group, or 41 per cent. of both groups, find their present contact with journals adequate. Fifty-nine per cent. of the groups desire from one to twelve additional journals, enough to raise the median desired to six journals for the first group and four journals for the second.

The teacher may of course use journals in the institution library, but usually only at a cost both of time and convenience that makes it a poor kind of economy. Are the institution library's journals adequate in the particular fields concerned? Thirty-two per cent. of the first group and 48 per cent. of the second suggest that more journals are needed in their fields at their college libraries.

Viewing private budget needs, it is always a fair question, can needs be met more adequately by a group service? Could books and journals be circulated from college libraries into offices and laboratories so that these would become working centers of library extension, and could private cost for books and journals be thereby lessened? Probably private cost could not be lessened as far as books and journals are concerned—the testimony of these correspondents is that private expenditures for both these professional needs should be much increased. Private professional libraries of a limited size probably meet practical needs, especially if new books can be secured freely, and teachers seem to favor using the institution library for that reserve collection of books which the scholar of an earlier day would have had in his home.

Professional books, just as the journal, are absolutely essential to the college teacher. Members of both groups own libraries that range from ten or fifteen to 2,000 volumes, with a median of 250 professional books, and they bought up to 110 professional books a year with a median of ten or fifteen profes-

¹ In the first group, to whom the schedule had to be submitted in two parts, sixty-four replied to the inquiry on professional needs and forty-eight to that on living conditions and financial security.

sional books purchased. In the first group the median library of the instructor is one hundred books; of the assistant professor and of the associate professor, 250, and of the professor, 500 books. Some private collection every teacher needs, but much increase in it would probably show diminishing returns unless library service could be provided. The housemaid who served this notice when the library reached about 1,500 volumes, "Tell the professor if I have to dust any more books, I'll get another job," struck at about the maximum reported by these correspondents. The question was asked, assuming that the number of books available for personal use were to be increased, what per cent. of the increase should go into the private library and what per cent. into the institution's library? The median preference for the two groups was that 20 per cent. to 25 per cent. of the increase should go into the personal library and 75 per cent. to 80 per cent. into the college library. Less than one fourth of these teachers would want over one half of such a hypothetical increase in their own libraries.

Are college teachers in touch with all the book resources needed for their work? Asked how much they could wisely increase personal purchases of professional books, the median opinion of both groups was for a doubling of present purchases of personal professional books and for the same doubling in the institution's purchase of books in their special field. A fourth of the group would add 200 per cent. to their own book purchases if possible. This indicates that present book allowances are inadequate in personal budgets.

Does the institution library need more books or better service? The answer, of course, is both, but, assuming that the institution were contemplating library expansion, how should the expansion be distributed between purchasing more books, and increasing service and efficiency? The opinions of the two groups on this question varied from a ratio of 0 per cent. for book increase and 100 per cent. for service increase, through a middle point of 50 per cent. for book expansion and 50 per cent. for service expansion, to 100 per cent. for book increase and 0 per cent. for service increase. The first group's median opinion was 50 per cent. for books and 50 per cent. for service; members of the other group in all three colleges had a median choice of 75 per cent. for book expansion and 25 per cent. for service expansion. This point of interrelationship of the teacher's and the institution's book and journal resources is one that merits detailed study. College book collections commonly need expansion, but also the library can come into closer service relations with student and staff and such an expanded service might possibly re-

lieve a little the pressure on the teacher's budget at this point or rather allow for its expansion for other books and journals needed.

Other Professional Expenditures: What personal expenditures are there for professional needs, in addition to books, associations and meetings and journals? The correspondents report personal expenditure for assistance, for research, for equipment, committee work, etc.

Assistance employed for assignable tasks frees the teacher for his specialized service and increases his output. It is wise institutional policy to provide assistance on its budget for those teachers who know how to use it; it is wise for the teacher to consider putting personal funds into assistance.

One half the first group and a quarter of the second group state that they desire personal funds for professional assistance of some kind. These personal needs for professional assistance, when specified, are for secretarial help, research assistant, technician, computation assistant, drawing assistant, abstractor, filing clerk, the sort of service that many colleges furnish as far as they can, but which teachers generally feel the need of in addition to aid thus given. Many are already putting personal funds into such assistance. Thus half (thirty-three) the first group of sixty-four spent from \$5 to \$1,000 each, with a median of \$50, for assistance; half spent from \$25 to \$150; one spent \$500, and one \$1,000. Of the second group, eight of forty-six report paying from \$20 to \$400 each for assistance. Such expenditures are doubtless often a way of accomplishing supplementary tasks as writing, etc., that pay their own way. A recommended policy might be: One who can afford it, will wisely use assistance at his own cost to multiply his professional production. One who must earn extra income beyond his salary may find that hiring assistance with personal funds is a way to earn extra income and at the same time conserve his energy and meet the full requirements of his position as teacher.

Do college teachers use personal funds for research? Seventeen of sixty-four in the first group and four of forty-six in the second, or about 20 per cent. of all, report expenditures within the year, and 15 per cent. report their desire for additional personal funds to be spent for research. Of twenty reporting an expense for research, the range was from \$15 to \$2,600, with the median at \$100 and half the group spending from \$50 to \$300. Should private expenditure for research become common practice? No doubt there should be almost complete reliance upon institution budget for assistance, equipment and other costs in one's institutional work. Nevertheless, an active worker is likely to have some private project under way, or there will be features of his general

program on which he will spend personal money at least occasionally. There is good ground for saying that the teacher's private budget should carry every year an item for research; it will make possible self-initiated studies important for his own advancement and wider service.

Wider Professional Needs: The college teacher needs a well-furnished mind with broad interests and contacts. Is he buying non-professional books and magazines? The first group buys from none to one hundred non-professional books a year with a median of ten, and takes from none to twelve general non-professional magazines with a median of three. From instructor up, these medians increase from one book and two magazines, to ten books and five magazines for professors. The second group buys from none to fifty books a year, with a median of three to four, and from none to fifteen magazines with a median of four. The purchase of five to ten books and three or more magazines may be considered typical of the groups reporting; it is a meager allowance and is supplemented one may hope through library and book club. One would desire for college teachers some experience with luxury defined as "money enough to order the books I want after reading the weekly book reviews."

One's budget should be so administered as to make the best use of vacations for uninterrupted study, writing and travel. There is certainly need for opportunity "to catch up," to get broader views, to plan syllabi and to organize one's material, to make contact with social or industrial conditions, to work on bibliography or to collect specimens, to give oneself continuously to some professional task. The sabbatical leave is a fruitful opportunity to this end, whether for a year at half pay, an arrangement which not all private budgets make possible, or the more easily managed half-year on full pay. The twelve monthly salary payments is an advantage over the ten monthly payments from this point of view; the quarter system in the academic year, with one quarter off on an accumulative basis, is another advantage. The forty-two sabbatical leaves reported by thirty of the 110 in the two groups have been spent as follows: in study, nine; travel and study, nineteen; teaching abroad, two; illness or resting, five; writing, five; teaching, one; government service, one.

In summarizing professional needs one may note that the most common recommendation of correspondents "to the young instructor regarding his professional needs" is: Make professional contacts, join the associations, attend meetings, read the journals, buy monographs, abstracts and books. Several say, "Devote at least 10 per cent. of income to professional development"; and one refines the advice thus, "If

you think you have ability, raise this allowance to 25 per cent. and gamble on your own future." Another says, "Sacrifice for professional expenditures—I have lost opportunities by failure to spend earlier." And another says, "Spend freely for professional needs in your early years, the proportion will be less later as you earn more."

LIVING CONDITIONS

The budget needs in connection with living expenses can only be understood by a complete examination of expenditures such as Professor Peixotto has made at the University of California and Messrs. Henderson and Davie at Yale.² The present paper raises only a few general points in this field.

Do college teacher's salaries meet their needs by providing adequate living conditions? If not, what are the shortages? Of the first group of forty-eight (the number replying to the remaining questions), 60 per cent. answered "fairly adequate"; 20 per cent. "entirely adequate." Of the second group, of forty-six, 58 per cent. reported "fairly adequate"; 28 per cent. "inadequate," and 13 per cent. "entirely adequate." The prevailing verdict is therefore that there is fair adequacy or better in living conditions, with a fifth or a fourth feeling that their living conditions are inadequate. Stated in another way, a fifth or less have living conditions that they consider entirely adequate.

Is this inadequacy subjective or objective? A Solomon would be needed to answer. But there were 137 objective shortages reported by sixty-seven of ninety-four persons, of which the more numerous were: recreation, thirty-three; service, nineteen; vacation, nineteen, and housing, fourteen. Among the other important shortages are: clothing, seven; doctor, one; family needs, three; children, two, and health, nine. The definite question as to whether health was safeguarded by living conditions was answered negatively by seven of forty-eight in the first group and by four of forty-six in the second group, or 11 per cent. of all who felt their health to be endangered by living conditions.

Probably most teachers would agree that living conditions should provide the college teacher a study at home, even if adequate space is also provided at the college building. Of forty-three in the first group, twenty-six have studies at home; seventeen have not. Of thirty-four in the second group, twenty-four have home studies; eight have not. Thus two thirds of those reporting have studies at home. Doing away with the home study would reduce housing costs,

² Jessica Peixotto, "Getting and Spending at the Professional Standard of Living." Macmillan. 1927. Henderson and Davie, "Incomes and Living Costs of a University Faculty." Yale University Press. 1928.

as one correspondent points out, and there is something to be said for doing one's work in an eight-hour day at college and using home as a leisure place. But there is certainly need for an undisturbed work place and for most teachers home provides this better than the college office. There are times for solitary work, times for working with students and times for meeting them socially.

Do college teachers maintain the old practice of welcoming students in their homes? Of these teachers, 72 per cent. do and two thirds of those who entertain students do not entertain as frequently as they would like to do.

What is the attitude of college teachers toward contributions to religious, charitable and social welfare enterprises? Of ninety-one teachers giving information, sixty-six gave to church, sixty-eight to charity, fifty-seven to alumni funds, thirty-two to non-family dependents, thirty-six to agencies of scientific progress, thirty-eight to causes related to social reform and eleven to other objects. In all, the ninety-one contributed to 312 objects as just defined, or 3.4 types of giving per person, although the individual objectives were many more. Society has a right to expect of the college teacher leadership in wise giving that will promote welfare, advance science and handle distress constructively. That two thirds give to alumni funds is worthy of note.

What rules the teacher's spending? Available income, large or small, and occupation are doubtless important controlling influences. The two groups were asked, "Income and occupation aside, what influences seem to determine your standard of living?" The forty-five metropolitan teachers ranked in order of importance seven influences, and on summarizing their ratings, "Our own choices and decisions" were accounted the most important influence, followed by these other influences in the following order: (2) usages of our academic community; (3) the mechanical age—auto, radio, etc.; (4) usages of our non-academic community; (5) the husband's parents' standards of living; (6) the wife's parents' standards of living; (7) our children's pressure for more expensive standards. The second group agreed in making personal choices the most important influence on standards of living, in putting the academic community ahead of the non-academic community and in putting parental and children's influences near the foot of the list. The judgments of married men in the two groups, counted separately in order to segregate cases where there were probably children, showed the same order of ranking.

But is personal planning and deciding as influential in standards of living as these teachers think it to be? Perhaps not—but personal ideals need be

fundamentally influential if college teachers are to meet their professional budget needs and provide for their financial security in the face of community pressure for luxurious spending. The fact that teachers feel that they control their choices in spending is a hopeful fact for the profession.

FINANCIAL SECURITY

Security in time of emergency is a searching test of any standard of living. Security requires an adequate income and the saving of a considerable part of it through insurance, annuity accumulation and reserves. The chief financial emergencies for which provision is necessary are interruptions to earnings through sickness, permanent disability, age-retirement and death of income provider, and also those occasional situations throughout the earning period which call for immediate outlays beyond the amount of current income and which can be met only by reserves or by personal credit. A program for security calls for life insurance that protects income in case of death of the earner; sickness and disability insurance or other provision of income for these periods; a retirement annuity that provides income after one has ceased to work regularly, and savings that give growing reserves, together with personal credit that enables one to borrow. Such a program of security is easy to state but it is impossible to realize unless current income is adequate. College teachers' incomes have often been declared inadequate. What facts do these groups of teachers present as to income and its adequacy for financial security?

First of all, as a group they have not found it possible to live on their academic incomes and are seeking supplementary incomes. Of forty teachers reporting in the first group, fourteen had only their college income and twenty-six had an income of 1.1 to 3 times their college salary, that is, they had supplementary income equal to from one tenth of to two times their salaries; the median salary of the forty was 1.25 times their stated salaries. Of forty-four teachers reporting in the second group, twenty had additional income and twenty-four did not; the median of all the group is 1.0 times the academic salary; but of the twenty having extra income the median salary is 1.25 times academic salary.

The incomes reported are "family incomes" and the supplementary amounts may come from the husband's extra earning, or from property of either husband or wife. Several correspondents stressed the need of supplementing teachers' incomes in order to meet pressing current needs; one advised, "Budgeting is of no avail, marry rich."

The most common supplement to current income is home ownership which adds to income the interest

value, or a little more, of one's investment. Of forty-eight large-city teachers (the first group) ten own residences, one a cooperative apartment and twelve country places or camps; of forty-six teachers in smaller cities, twenty-two own residences and two own country places.

Income During Disability: Home ownership is protection in sickness or other emergency. What income could these teachers command at such a time? In the first group, twenty-two reported a possible sickness income of from 5 to 55 per cent. of salary with a median of 25 per cent. of salary, and twenty-one reported a median income during permanent disability of 40 per cent. of present salary. In the second group ten of forty-six reported a median sickness income of 20 per cent., and twelve reported a median disability income of 25 per cent. of regular income. What of those who do not report? Here is a serious emergency apparently not prepared for. Some life insurance policies carry a disability clause whereby the policy matures in case of disability. The fact that group life insurance with its inexpensive supplementary life insurance often provides also for sickness and disability income insurance, and the fact that teachers' retirement annuities provide also for disability income, are important considerations in one's program for personal security. Of course whatever the teacher can accumulate is a reserve in sickness and in disability.

Are college teachers generally using the familiar institutional retirement annuity plan of paying 5 per cent. from salary and having 5 per cent. added by the institution? Or, if individuals are not utilizing it, are they buying an annuity elsewhere? The returns from both groups indicate that the annuity has not yet been accepted by college teachers universally as financial opinion has advised should be done. In the first group, of thirty-seven reporting, twenty-six are buying annuities (eighteen in the college plan and eight elsewhere), and eleven are not buying annuities. In the second group, of twenty-one reporting, eleven are buying annuities and ten are not. Probably somewhere between 40 per cent. and 60 per cent. of these groups are buying annuities.

Are these college teachers hoping to accumulate funds privately, by the time of retirement? They were asked how much personal capital or principal they anticipated saving by the age of sixty-five in addition to the annuity: the estimates from thirty of forty-eight in the first group vary from one half of to forty times the present income, with the median expectancy of five times the present income for retirement capital. Of the second group twenty of forty-six estimate this accumulation at a median of four times present income. The importance of some retirement capital in addition to a retirement annuity

can not be overstressed because of probable emergency costs of illness and the like after retirement.

May teachers anticipate success in private accumulation or are investment losses common in this group? For both groups, 26 per cent. have experienced investment losses. The losses mentioned were: stock, four times; real estate, three times; bonds, twice; real estate bonds, twice; cooperative banks or building loans, once; farming, once.

How much are college teachers able to save? Last year's balance between income and expense for forty-four of the first group showed seven persons with deficits, two breaking even, and thirty-five with surplus of from 5 per cent. to 150 per cent. of salary with a median for all of a surplus of 20 per cent., counting as surplus all payments for insurance, for annuities, home purchase, savings, etc. In the second group, thirty-four reported; three with deficits, six breaking even and twenty-five with surplus up to 100 per cent., the median for all being a surplus of 10 per cent.

What causes these deficits when they do occur? Of thirty-four persons giving reasons for deficits, twenty-eight mentioned illness, hospital, birth or death costs, including such devastating items as illness and hospital bills for \$1,000 and \$2,000. Further social planning regarding these emergency costs due to illness is needed for teachers and all workers. The plan of one college of an officers' emergency fund, to which contributions of one fifth of 1 per cent. of salary are made, to be drawn upon either for loan or for outright grants if grants are justified, is one constructive plan providing defense at this dangerous point. Other emergencies causing annual deficits were: costs of moving; costs for family dependents, and education of children.

Life insurance seems to be universally used for protection in case the income-provider is taken away. Of forty-eight in the first group, thirty-nine reported their insurance to be in amount from one fifth the annual income to ten times that income with the median insurance at three times the salary, with half carrying from one to four and one half times the amounts of their salary. Of forty-six in the second group, thirty-five reported insurance from one half to six times the annual income. The median and the mode is three times, eleven of the thirty-five carrying that amount. An insurance fund of three times the income at 6 per cent. interest would produce only 18 per cent. of the salary as an income for beneficiaries, and unless largely supplemented by savings is not adequate protection. The insurance facts for twenty-three married men teachers showed protection ranging from .5 to six times the amount of salary with the median and the mode at three times the salary, the same ratio as for the whole group.

The teachers of one institution, in addition to personal life policies, carry group insurance of from \$2,000 to \$5,000, approximately equal to the amount of the salary; with a provision for sickness income of from \$25 to \$40 for twenty-six weeks, and for disability income insurance for five years of one fifth of the face of the policy per year. This group policy is paid partly by the college but largely by the insured, costing them, for example, \$67 and \$84 a year for the \$4,000 and \$5,000 policies, respectively. The institution as employer usually buys such insurance, but a club or cooperative group including 75 per cent. of a staff can secure this at about \$8 a \$1,000 for each life policy plus charges for sickness and disability insurance.

Financial security of the teacher depends partly, we have seen, upon supplementary income, but especially upon such measures as: home ownership, life insurance, sickness and disability provision, retirement annuities and plans for saving. Based on the preceding facts there is offered in conclusion a tentative program of allowances for the budget needs of college teachers.

TENTATIVE BUDGET

The essential problem of the college teacher's budget is to find the wise balance between: (1) professional needs; (2) the requirements of daily living, and (3) necessary provision for financial security of self and family. As a tentative plan the suggestion is offered: (1) a minimum of 10 per cent., more or less, for professional needs; (2) 15 to 20 per cent. for financial security; (3) 75 per cent. or thereabouts for living expenses. Such a formula may not be workable on a small income, but it is suggested here to illustrate essential expenditures for professional needs and security.

Professional needs call ideally for a minimum of from \$300 to \$400 a year, or more, to provide:

- (1) Membership in from four to five or more professional organizations costing from \$10 to \$25 up.
- (2) Attendance upon professional meetings, one or two or more, costing from \$50 to \$100 up.
- (3) Professional books, about fifteen or more, costing from \$30 to \$50 up.
- (4) Professional journals, four or five or more, costing from \$10 to \$25 in addition to association memberships.
- (5) Expenditures for personal professional work, including clerical assistance, research, equipment, committees, etc., \$100 a year or more.
- (6) Professional travel and cultural expense which if unexpended is to accumulate for the sabbatical leave, \$100 a year or more.

The fundamental justification of professional expenditures is that the teacher is a productive worker

who should every year reinvest in his work part of his annual income. Every successful business plows in part of its surplus to increase its productivity; a progressive teacher will do the same. The precise items of professional need and the sums of money required can be determined only by a more extensive research. This suggestion runs counter to the idea that a teacher should depend entirely upon his institution's budget for professional expenditures. The institution should of course carry the ordinary costs of clerical assistance, assistance in research, research equipment and the like. But any individual who grows will have some self-initiated research for the cost of which he is himself responsible.

Financial security for the college teacher calls ideally for 18 per cent. of income, more or less, distributed as follows:

- (1) Retirement annuity, 5 per cent. of income, with the institution contributing 5 per cent. more; and the annuity's reserve accumulation available in case of permanent disability or death before retirement.
- (2) Life insurance costing 6 or 7 per cent. of salary, to give a minimum protection of about three times the amount of salary; increased by term insurance during dependency of children and until annuity reserve accumulates; or increased by group life insurance costing 1½ per cent. of salary and giving life insurance equal to one's salary, plus disability and sickness insurance.
- (3) Sickness and disability income provided: (a) by group insurance as just mentioned; (b) by disability provision through a disability clause in one's regular life insurance policy; (c) if desirable by a special sickness and disability insurance of \$100 a month, costing about \$50 a year; (d) a provision against unusual emergency expenditures provided (1) possibly in part by an officers' emergency fund through pooling 1/5 of 1 per cent. of salary; (2) or by some insurance for family sickness costs yet to be worked out; and (3) at any rate by hedging against these emergency needs by a personal reserve fund (see 4 below).
- (4) Additional financial reserves, of 5 per cent. of salary, to accumulate safely in a form available as collateral for loans in emergency needs; and to provide some retirement capital in addition to annuity.

Living conditions, for the college teacher, should be appropriate to his professional and social responsibilities, and for this about 75 per cent. of the budget should be allotted. This expenditure, in addition to meeting the usual costs of living for self and family, should provide for the teacher a home study properly equipped, facilities for entertaining students and other guests and, in general, conditions which will promote efficient service in his double function of teacher and scholar.

SALARIES AND SUPPLEMENTARY EARNINGS OF COLLEGE TEACHERS

By FRANK P. BACHMAN

DIRECTOR OF THE DIVISION OF PUBLIC EDUCATION, GENERAL EDUCATION BOARD, NEW YORK CITY

A LETTER of 1919 from Mr. John D. Rockefeller, transmitting funds to the General Education Board, contained these significant words:

It is of the highest importance that those entrusted with the education of youth and the increase of knowledge should not be led to abandon their calling by reason of financial pressure or to cling to it amid discouragements due to financial limitations. It is of equal importance to our future welfare and progress that able and inspiring young men and women should not for similar reasons be deterred from devoting their lives to teaching.

In view, therefore, of the vital relation between adequate financial support and the achievement of the high aims of education, it becomes important from time to time to study the salaries of college teachers. The General Education Board has provided for two such studies within recent years—Occasional Papers, No. 7, 1921, and Occasional Papers, No. 8, 1928, by Mr. Trevor Arnett, now president of the General Education Board.

This paper on "Salaries and Supplementary Earnings of College Teachers" is based on the data contained in Occasional Papers, No. 8.

The data on teachers' salaries to be presented hereafter were drawn from reports received from 302 colleges of arts, literature and science or corresponding colleges or departments of universities, representing all parts of the country. Of these, 262 are men's and coeducational institutions and forty are women's colleges. The data presented cover the salaries for 1926-1927 of 15,361 liberal arts teachers, of four professional ranks: (1) professors, (2) associate professors, (3) assistant professors and (4) instructors.

The average salary of all liberal arts teachers in the 302 institutions under consideration in 1926-27 was \$2,958. This is an increase over 1919-20 of 30 per cent.

The average salary paid in 1926-27 varied according to geographical divisions:

New England States	\$3,385
Middle Atlantic States	3,214
Southern States	2,660
Middle Western States	2,808
Western States	2,960

It will be noted that the average salary paid liberal arts teachers in 1926-27 was the highest in New England (\$3,385) and the lowest in the southern states (\$2,660).

The average salary paid in 1926-27 to liberal arts teachers naturally varied with professional rank:

Professors	\$3,798
Associate professors	3,256
Assistant professors	2,669
Instructors	1,941

These in turn varied according to size of institutions:

Rank	Class A	Class B	Class C
Professor	\$4,573	\$3,444	\$2,748
Associate professor	3,514	2,702	2,457
Assistant professor	2,812	2,440	2,146
Instructor	1,997	1,888	1,639

If comparison is made between the average salary paid teachers of the same professional rank by men's and coeducational institutions and by women's colleges of the same size—for example, Class A—it will be found that the average salary is somewhat higher for all professional ranks in men's and coeducational institutions than in women's colleges.

A comparison of average salaries of teachers in colleges of arts, literature and science with the average salaries of teachers in professional and technical schools, such as agriculture, commerce, education, engineering, is both illuminating and instructive. The average salary paid teachers in schools of different types in 1926-27 was as follows:

Type of institution	Number of teachers included	Average salary
Liberal arts colleges	302	\$2,958
Agriculture	32	3,149
Commerce	38	3,307
Education	48	3,438
Engineering	73	2,989
Fine arts	21	2,633
Law	57	5,197
Medicine	46	3,391
Music	26	2,388
Theology	22	3,889

It thus appears that the lowest average salary (\$2,388) is paid in schools of music; the next lowest (\$2,633) is in schools of fine arts, and the third lowest (\$2,958) is in colleges of arts, literature and science. The highest (\$5,197) is in schools of law.

Up to this point we have been dealing with average salaries. Quite as significant, if the salary status of

teachers in colleges of arts, literature and science is to be made clear, is the distribution of teachers, irrespective of rank, at the several levels of a given salary scale. In 1919-20 the median salary of teachers in the 302 institutions under consideration was \$2,066. That is, in 1919-20 half the teachers in these institutions received an annual salary of \$2,066 or less, and half received more. By 1926-27, the median salary of teachers in these institutions had risen to \$2,704. The significance of this increase over 1919-20 lies in this fact: In 1926-27, 50 per cent. of all teachers in these 302 institutions received an annual salary of more than \$2,704, whereas in 1919-20 only 27 per cent. received as much as \$2,704. In other words, not only has the average salary increased since 1919-20, but also the median salary, and in consequence a larger proportion of teachers received the higher salary in 1926-27.

A study of the range of salaries is equally significant. Of the 15,361 teachers in the 302 colleges of liberal arts under consideration, 92 per cent. receive less than \$5,000; 99 per cent. receive less than \$7,500; and only 16, or .01 per cent., receive \$10,000 or more. These sixteen most favored are all of professorial rank and are the chosen out of 4,728 teachers of this rank in the institutions under consideration.

Whether the salaries of teachers in the institutions under consideration have actually increased over 1919-20 depends, of course, on what has happened in the meantime with the cost of living and the purchasing power of the dollar.

Reliable studies have been made of these questions. On the basis of information provided by these studies, it appears that there has been a decrease in the cost of living for the period covered in this study. Therefore, the increases in teachers' salaries between 1919-20 and 1926-27 are real increases. Teachers have profited in two ways—by the decreased cost of living and by the increase in the number of dollars received for their services. Their economic status in 1926-27 is clearly an improved one, but what can be said of it as compared with the economic status of teachers in 1914-15, which was used as the basis of comparison in the previous study of teachers' salaries made by Mr. Arnett?

The average salary of teachers in the 302 institutions under consideration, as previously stated, was for 1926-27 \$2,958, and for 1919-20 it was \$2,279. The average salary in 1914-15, as computed from the data given in Occasional Papers, No. 7, for the corresponding professional ranks was \$1,724. When the nominal average salaries for the respective years are equated in terms of the purchasing power of the dollar for the corresponding years—\$1.00 for 1914-15,

\$1.489 as of July, 1920, and \$.617 as of July, 1927—the nominal average salaries and the real average salaries for teachers in the institutions under consideration for these years are as follows:

Year	Nominal average salary	Real average salary
1914-15.....	\$1,724	\$1,724
1919-20.....	2,279	1,114
1926-27.....	2,958	1,825

There was a distressing depreciation, it appears, in the real average salaries of college teachers from 1914-15 to 1919-20. The increase in 1926-27 over 1919-20 has been material and is gratifying. Nevertheless, despite all the efforts exerted in recent years to improve their economic status, teachers in the 302 institutions under consideration were only slightly better off financially in 1926-27 than like workers in 1914-15. However, the emergency existing in 1919-20 has been met, and the salaries of teachers in higher educational institutions, it appears, are at least again on a pre-war basis.

Salaries for the regular school session are not the only earnings of teachers. They supplement their regular earnings, as we shall see, in different ways. Information was acquired from 11,361 teachers as to the character and extent of these supplementary earnings. The data previously presented with regard to teachers' salaries from the 302 institutions under consideration were practically complete for all teachers in these institutions. Data now to be presented on the supplementary earnings of teachers were supplied by the teachers themselves, but replies were by no means obtained from all the teachers in the 369 institutions from which reports were received. Replies from teachers on which the subsequent discussion is based are therefore only a sampling; nevertheless, we have reason to believe that, so far as they go, they are reliable.

Of the 11,361 teachers replying, 7,557, or 67 per cent., reported that they supplement their salaries by earned income. That such a large proportion of teachers in colleges of arts, literature and science engage in activities in addition to their regular duties raises a serious and fundamental question. Is teaching in liberal colleges a full-time or a part-time job?

The proportion of teachers supplementing their regular salaries apparently increases, contrary to what might be expected, with professional rank. For, when the replies are tabulated by professional rank of teachers replying, the per cent. supplementing their salaries is as follows:

	Per cent.
Professors	76
Associate professors	70
Assistant professors	63
Instructors	52

Apparently, the higher the professional rank, the greater the economic pressure.

What, now, do teachers find to do in their efforts to add to their earnings?

Their supplementary activities are numerous, but may be classified under writing, extra teaching or institutional services, lectures, consulting and miscellaneous activities. Of the 7,072 teachers from whom we have complete information, both as to regular salary and as to amount and character of supplementary earnings, 70 per cent. do extra teaching or institutional services either in their own or other institutions and earn by extra teaching practically one half of all supplementary earnings. However, this does not mean that those included in this group do no other kind of supplementary work. For example, part of the group may also lecture. The next most popular field after teaching is writing, with 25 per cent.; 20 per cent. lecture; 10 per cent. do consulting work, and 25 per cent. engage in miscellaneous services. Teachers reporting from urban institutions apparently find greater opportunity for writing, extra teaching and institutional services and consulting work than teachers reporting from rural institutions. In lecturing and miscellaneous services the comparison is in favor of teachers reporting from rural institutions.

The total supplementary earnings of these 7,072 teachers who do extra work is equal to 24 per cent. of their regular annual salaries. The range of such earnings is very wide, ranging from less than \$100 to \$10,000 or more. The median supplementary earning is \$522. Less than one fourth make as much as \$1,000 or more, and 7.7 per cent. as much as \$2,000 or more. A very few succeed in earning considerable sums: seventy-seven out of 7,072 earn \$5,000 or more, and thirteen earn \$10,000 or more. It also appears that the higher the professional rank and the higher the regular salary, the larger the amount earned by additional work.

In view of the relatively low salaries of teachers in liberal arts colleges, it might be inferred that teachers in general who undertake supplementary work do it entirely from economic necessity. This, however, is not altogether borne out by the facts. For of 6,550 teachers who gave definite replies as to whether they did outside work from necessity or from choice, 72 per cent. stated that they preferred to do regular work only, and 23 per cent. did addi-

tional work from choice. That is, about one fourth of all teachers who supplement their salaries prefer to do this rather than devote their entire energies to their regular work. On the other hand, about three fourths apparently feel that teaching in a liberal arts college is a man-sized job, worthy of their energies and full devotion.

Nor does appreciable private income apparently have much effect upon whether teachers do or do not undertake additional work. Teachers reporting were left to define in their own terms what they considered appreciable private income. Of the 2,132 teachers reporting appreciable private income, 65 per cent. supplemented their salaries, as compared with 69 per cent. of those who presumably do not have appreciable private income. Of those who reported appreciable private income and who supplemented their salaries, 45 per cent. stated that they did it from necessity.

Of the many factors compelling teachers under present salary conditions to supplement their regular incomes, perhaps none is more important than family responsibility. Of the 7,776 married teachers replying, 77 per cent. supplement their regular salaries, as compared with 47 per cent. of the 3,927 single teachers. When comparisons are made by rank, 82 per cent. of the married professors replying do additional work, as compared with 52 per cent. of unmarried professors. The corresponding percentages for married and unmarried instructors are 66 and 43.

A study of the supplementary earnings of teachers and of the reasons why additional work is undertaken, therefore, shows that, while a goodly proportion of teachers claim to undertake outside work from choice, and a small proportion may not need to do additional work because of appreciable private income or because they are unmarried, the fact remains that under present salary conditions teachers in general are compelled to supplement their salaries by outside work, and for the majority this means more teaching.

To conclude: There is indisputable evidence that the salaries of teachers in colleges of arts, literature and science increased about 30 per cent. from 1919-20 to 1926-27, and that the average annual salary of all such teachers has risen from \$1,724 in 1914-15 to \$2,958 in 1926-27. It is, however, equally clear that the real average increase has only been from \$1,724 in 1914-15 to \$1,825 in 1926-27. Nevertheless, slight as this real increase has been, it has been sufficient to meet the salary crisis of 1919-20, and sufficient to give teachers a slightly more favorable financial position than heretofore. Favorable as their present financial status appears in comparison with the past, it yet remains that present salaries are inadequate, and that almost two thirds of the teachers in colleges

of arts, literature and science are compelled to take on additional work to meet their economic needs. Those entrusted with the education of youth and the increase of knowledge still follow their high calling amid financial discouragements, and, because of un-

favorable financial prospects, able and inspiring young men and women are still deterred from devoting their lives to teaching.

(Further contributions to the discussions, by Professor Rodney H. True and Professor Harold F. Clark, will appear in the next issue of Science.)

OBITUARY

PROFESSOR JOHN A. MANDEL

ON Sunday, May 5, 1929, Professor John Alfred Mandel died after an illness of two years' duration. His death was due to myocarditis, and he bore the slow and insidious developments of this disease with fortitude.

Professor Mandel was born on October 18, 1865, in Stockholm, Sweden, and was brought to this country by his parents at the age of five. The family settled in Boston, Massachusetts, where he received his early education in the public schools and the English High School of Boston. Later he studied at the University of Berlin, specializing in chemistry and allied sciences. He received the degree of doctor of science from New York University in 1901.

He was married in 1891 to Paula A. Heinrich, of Berlin, Germany, who survives him.

His academic career began in 1884 when he became the assistant to Professor Charles Doremus at the Bellevue Hospital Medical College. In 1894 he accepted the appointment as professor of chemistry in the New York College of Veterinary Surgeons, and held this position until 1897. From 1897 to 1898 he was assistant professor of chemistry and physics at the College of the City of New York, and at the same time was adjunct professor of chemistry at the Bellevue Hospital Medical College. From 1898 until his death he was professor of chemistry in the University and Bellevue Hospital Medical College of New York University.

Throughout his career Professor Mandel took active interest in scientific societies here and abroad. He was a member of the following: American Chemical Society, American Physiological Society, American Association for the Advancement of Science, Society of Biological Chemists, Society for Experimental Biology and Medicine, Harvey Society, Deutsche Chemische Gesellschaft and an associate fellow of the New York Academy of Medicine. In addition, he was a member of the Century Association of New York, and the Nu Sigma Nu and Phi Gamma Delta fraternities. He attended practically all the International Physiological Congresses for the past twenty-five years.

He was a man of broad culture and an indefatigable research worker in chemistry, having contributed many original papers to the chemical journals.

His researches were carried out independently in part, as well as in collaboration with Carl Neuberg, P. A. Levene, E. K. Dunham and Hans Oertel.

The principal field of his researches was the chemistry of nucleic acid, and he published papers on nucleic acids and glutathionic acid of the mammary glands; on nucleic acids and their cleavage products and also on the origin of glycuronic acid.

Professor Mandel's translation of Hammarsten's well-known "Lehrbuch der Physiologischen Chemie" was first done in 1893, and he translated five subsequent editions of the book, thereby furnishing a most valuable aid to the biological chemists of this country and England. He also translated Arnold's "Repetitorium der Chemie."

His own works include a "Handbook for the Biochemical Laboratory," 1896 (J. Wiley and Sons); "Handbuch für das Physiologische-Chemische Laboratorium," 1897 (M. Krayn, Berlin), and "Micro-metrische Methoden der Blutuntersuchung," in collaboration with Dr. Steudel, Berlin, 1921, first edition (translated into Italian, 1924), 1924 second edition.

In 1912 Professor Mandel was created a Knight in the Order of the North Star by King Gustave of Sweden for his scientific work and writings, and received in 1914 the Rote Kreuz Medaille from Emperor Francis Josef of Austria for his work in the Austrian Red Cross. In 1923 the honorary degree of doctor of agriculture was conferred upon him by the University of Berlin, and in 1926 he was elected a member of the German Academy of Natural Sciences of Halle. In 1924 he was made an honorary member of the Berliner Physiologische Gesellschaft. He was a frequent and welcome guest in many of the cultural centers of Europe, especially in Germany, where he carried on investigations in numerous laboratories, and but a short time ago was the recipient of an invitation from the George Speyer Laboratory for Chemotherapy, the scene of Paul Ehrlich's activities, which extended to him its courtesy for a whole year.

Professor Mandel will be best remembered by his thousands of students for his eloquent and forceful teaching. He was a splendid and inspiring lecturer and had the rare ability to impart his knowledge. Many of his students will remember his kindly sympathy and ready help in their difficulties. His life is best summed up as one of devotion to his students

and science. His death is a profound loss and is mourned by his friends, associates and students who revere his memory.

W. C. MacTAVISH

RECENT DEATHS

DR. PAUL A. LEWIS, of the department of animal pathology of the Rockefeller Institute for Medical Research, Princeton, N. J., who has been studying yellow fever in Brazil, died of the disease in Bahia on June 30. Dr. Lewis was born in Chicago in 1879, and held the medical degree of the University of Wisconsin. He was professor of pathology at the University of Pennsylvania from 1910 to 1923.

WILLIAM SYMES ANDREWS, an Englishman who came to the United States to work with Mr. Edison in 1879, and who for thirty-five years has been associated with the General Electric Company, especially in investigations on X-rays, died on July 6, in his eighty-second year.

DR. WILLIAM A. GIFFEN, a former president of the American Dental Association, has died at the age of sixty-three years.

THE death is announced at the age of sixty-eight years of Dr. Robert John Harvey-Gilson, emeritus professor of botany in the University of Liverpool.

SCIENTIFIC EVENTS

THE OPENING OF DOWN HOUSE

DOWN HOUSE, the home of Charles Darwin, at Downe, in Kent, which has been presented to the British Association by Mr. Buckston Browne as a national memorial of the great naturalist, was declared open to the public on June 7 by Sir Arthur Keith. The *London Times* reports that the opening was attended by a large company, who traveled to Downe from Burlington House in motor-omnibuses, the village being remotely situated, four miles from Orpington, the nearest railway station, and unserved by public conveyance. After leaving the high-road, the way to the house lies through miles of country lanes.

As the *Times* recalls, Down House was purchased for Darwin by his father, Dr. Darwin, and he took up his residence there on September 14, 1842. Darwin was then in his thirty-fourth year, and three years previously he had married his cousin, Emma Wedgwood. His reason for moving into the country was, as he said, that attendance at scientific societies and ordinary social duties in London threw too great a strain on his rather indifferent health.

Darwin worked continuously at Down House for almost forty years. Preparations for the "Origin of Species" went on from 1842 until the work received its final form in 1858-59. As has been well said, from Down Charles Darwin shook the world and gave human thought an impress which will endure for all time. Down was also the home of a large and happy family, perhaps the most gifted family ever born in England. There the great naturalist died on April 19, 1882, in his seventy-fourth year.

Mr. Buckston Browne has preserved numerous articles associated with Darwin's daily life. Among them are the snuff-jar which Darwin kept, not in his study but in the hall, in the vain hope of breaking himself of the habit, and the grand piano on which

Mrs. Darwin used to play when her husband came to the drawing-room after his regular periods of two hours' work. In the study is his circular revolving writing table fitted with many drawers, and his chair. In other rooms there are replicas of the portraits of Darwin and Huxley, painted by Mr. John Collier, commissioned by Mr. Buckston Browne. The bust of Darwin by Mr. Charles Hartwell, R.A., now in the Royal Academy, is to be removed to Down House as a present from Dr. Joseph Leidy, representing the American Association for the Advancement of Science. Another interesting gift is the microscope given by Darwin to John Lubbock (afterwards Lord Avebury) when he was a boy.

Sir William Bragg, president of the British Association, presided at the opening and addresses were made by Mr. Buckston Browne, Sir Arthur Keith, Dr. Joseph Leidy, representing the American Association for the Advancement of Science, and Professor R. Anthony, representing France.

THE JOINT MEETING OF THE FRENCH AND BRITISH ASSOCIATIONS AT HAVRE¹

In 1914, while the British Association was meeting in Australia, the delegates of the corresponding societies were invited as guests at the conference of L'Association Française pour l'Avancement des Sciences, then being held at Havre. Those who were present will remember the hospitable way in which they were entertained at the Hotel Frascati, at the meetings and excursions, though as day by day passed there seemed to be something mysterious going on; the hotel gradually emptied, there were signs and whisperings, the members were impressed by the enormous accumulation of foodstuffs in the warehouses, and before the meeting was closed the declaration of war explained a good deal. The members had to find their way back

¹ *Nature*.

to England as best they could, and those who had the experience will never forget it.

The French Association, towards the end of July this year, again meets at Havre, and as the principal members of the British Association will then be at South Africa, our French colleagues have again extended the courtesy of inviting the other members of the British Association to attend its conference at Havre without any extra fee beyond the ordinary subscription to the British Association, which would be paid in any case.

In addition, the French Association has invited the delegates of the corresponding societies to hold their conference during the Havre meeting, and in connection with this a subcommittee was appointed consisting of the president of the Conference of Delegates, Dr. F. A. Bather; the secretary, Dr. C. Tierney, and the acting secretary for the Havre meeting, Mr. T. Sheppard. Sir Henry G. Lyons was also appointed the official representative of the British Association and chairman of the organizing committee referred to.

At the Glasgow meeting of the British Association, Dr. A. Loir, whose courtesy was so much appreciated in 1914, was present and gave an official invitation to the general committee of the British Association and was prepared to do the same for the conference of delegates, but apparently that body was too fully occupied to spare the necessary time. Mr. T. Sheppard has recently visited Havre and met the chairman of the local committee (the English consul, Mr. H. C. Swan), Dr. Loir, and others interested in the local arrangements. The Hôtel des Sociétés Savantes, next to the Lycée de Garçons, where the meetings of the French Association will be held, has been generously placed at the disposal of the British Association for any special meetings, etc. These rooms provide a general meeting room for the delegates, a committee room, and an exhibition room. During the conference, Dr. Bather will give an address on museum matters to a section of the French Association, and Dr. Pullein will speak on radiology at the request of the association. The conference of delegates will be held at 5 P. M. on July 26, when the question of the Channel Tunnel from both engineering and geological points of view will be discussed. The British committee is arranging an exhibition of air photographs, regional survey maps, etc.

The French Association commences its program on Thursday, July 25, at 11 A. M., when the opening session will be held at the Grand Theater. In the afternoon is the organization of the sections, and in the evening a reception by the corporation at the Town Hall. On Friday, July 26, there will be papers and discussions; visit to exhibitions organized at the

Lycée de Garçons of natural sciences by the Geological Society of Normandy and the Linnean Society of the Seine Maritime, and exhibits by the civil engineering, dentistry, meteorological sections, etc.; visit to the Port and a liner, and a conference at the Grand Theater. On Saturday, July 27, there will be a visit to the English exhibitions and museum; visit to the museum at Old Honfleur, and a public conference in the Franklin Hall. Sunday, July 28, will be occupied by a general excursion to Fécamp, and the unveiling of a monument to Dr. Léon Dufour. On Monday, July 29, further discussions, visits to various buildings, and in the afternoon an excursion to the Art Gallery and New Archeological Museum at Graville Abbey. In the evening there will be a soirée at the Municipal Casino or on a liner. Tuesday will be occupied by papers and discussions and the closing session. On Wednesday, July 31, and Thursday and Friday, August 1 and 2, there will be final excursions to Grouville, Lisieux, Caen, Bayeux, Mont St. Michel, and Rouen and district.

Inquiries in reference to the meeting should be addressed to Mr. T. Sheppard, at the Museum, Hull, or to Dr. A. Loir, Comité Local, Hôtel de Ville, Le Havre, France.

THE ROYAL GEOGRAPHICAL SOCIETY

At the annual dinner in London of the Royal Geographical Society held on June 24, Sir Charles Close, president of the society presided, and Prince George made the principal address.

The council of the society made the following awards:

MURCHISON GRANT to Mr. C. S. Elton, for his three seasons' study of the distribution of life in Spitsbergen, which has added materially to our knowledge of the geographical distribution of the flora and fauna of that country. Mr. Elton has taken an important part in the expedition from Oxford University which has been studying the distribution of life in Arctic regions.

BACK GRANT to Mr. C. P. Visser, for his exploration of the Hunza-Karakoram glaciers. This was described as a piece of geographical work long overdue. As Mr. and Mrs. Visser were believed to be on yet another expedition on the Indian border, it was not certain that they were yet aware of this recognition of their services.

GILL MEMORIAL to Mr. George Dyott, for his recent expedition in search of Colonel Fawcett, of whom nothing had been heard since a few weeks after he left Cuyaba in May, 1925, on his long-considered expedition in the most difficult region of Matto Grosso. What Mr. Dyott learnt on his journey goes very far, it was feared, towards establishing the fact that Colonel Fawcett and his son and Mr. Raleigh Rimell were killed by hostile Indians. The Gill Memorial was established by Miss Gill in memory of the gallant brother who lost his life in the Syrian Desert with Professor Palmer some 45 years ago.

CUTHBERT PEEK GRANT to Mr. Donald Cameron (Lieutenant, Royal Scots), for his journey across the Sahara from Nigeria to Algiers. He described himself modestly as an "ignorant though inquisitive traveller" who preferred to come home on leave from Nigeria by an unusual route. His journey demanded endurance and courage beyond the ordinary, for his party was lost and without water for 10 days. His description of the desert route east of Ahaggar Massif is described as a valuable contribution to our knowledge; and the council hope that the award may serve not only as a recognition of a fine journey performed, but a stimulus for further travel, as was the intention of its founder.

THE RETIREMENT OF DEAN VERANUS A. MOORE OF CORNELL UNIVERSITY

DEAN VERANUS A. MOORE, '87, of the college of veterinary medicine, concludes this year a teaching career of thirty-three years at Cornell University. He was a member of the first veterinary faculty as professor of veterinary pathology and bacteriology in 1896 and in 1908 became dean of the college.

In connection with his retirement, the faculty of the college voted the following resolution:

WHEREAS, The age of retirement from the active duties of administration and instruction has been reached by Veranus A. Moore; and,

WHEREAS, His faithful and exemplary service as head of the department of pathology and bacteriology for twelve years, and his conscientious and effective service in the high office of dean of the State Veterinary College for twenty-one years, has resulted in the development of an institution second to none in research and instruction in veterinary subjects and has assisted materially in placing the veterinary profession on a plane with other learned professions; and,

WHEREAS, His devotion to the insistence on high ideals have been a potent factor in strengthening the college and uplifting the profession; and,

WHEREAS, His modest and unselfish personal attributes have endeared him to his colleagues, to the alumni and students, and to the profession at large; be it

Resolved, That we, his colleagues in the faculty, assure him of our appreciation of the invaluable service he has rendered in the fields of veterinary education, animal industry and public health, and that his indefatigable energy and sound judgment have brought honor and

prestige to the college—thereby reflecting credit upon his associates; and, be it further

Resolved, That while we regret his retirement from the official duties of the college, we trust his wise counsel and advice may still be available in the years to come. We further express the hope that his future may be peaceful and serene and he may feel that the burdens he has borne are compensated for, in part, by the respect and admiration of his friends. We are grateful for the example of his life, his career of usefulness and unselfishness, and assure him that, in our opinion, the world is better for his having lived in it.

GRANTS-IN-AID FUND OF THE NATIONAL RESEARCH COUNCIL

THE Rockefeller Foundation has made available to the National Research Council a limited fund from which the council can make grants-in-aid of comparatively small amounts to help support the research work of individual American investigators and of special projects of restricted extent.

This fund will be administered by the National Research Council in much the same way that its funds for research fellowships are now administered. A special committee of the Council has been established, composed of the chairman, the treasurer and the permanent secretary of the Research Council, together with the chairmen of the council's seven divisions of science and technology. Dr. George K. Burgess will act as chairman of the committee and Dr. Vernon Kellogg as secretary.

The committee will hold occasional meetings beginning approximately October 1 to consider and pass on applications. Such applications should not be for fellowships, honoraria, nor publication costs, but may include field expenses. They should be made well in advance of the time of the intended use of the funds and should include detailed information as to the special qualifications of the applicant to pursue the investigations for which financial assistance is asked, and a statement of other support received or expected. The committee hopes that the universities and other interested organizations will cooperate with it in the proposed modest assistance of worthy research workers.

Correspondence should be addressed to the Secretary, National Research Council, Washington, D. C.

SCIENTIFIC NOTES AND NEWS

PRESIDENT HERBERT HOOVER will be the honorary president of the First International Congress on Mental Hygiene which will be held from May 5 to 10, 1930, in Washington, under the auspices of the National Committees for Mental Hygiene in this country and in Canada, together with the national

societies for mental hygiene in all other countries in which the movement has been organized.

DR. SIMON FLEXNER, the director of the Rockefeller Institute for Medical Research in New York, was elected on June 6 a corresponding member of the Reale Istituto Lombardo di Scienze e Lettere of

Milan, Italy, in the medical section of the class of mathematical and natural sciences.

PROFESSOR G. H. PARKER, director of the Harvard Zoological Laboratory, has been elected a corresponding member of the Peking Society of Natural History, Peking, China.

DR. ROSS G. HARRISON, professor of comparative anatomy at Yale University, has been elected a member of the Norwegian Academy of Sciences.

BELOIT COLLEGE at its recent commencement conferred the degree of doctor of science on Dr. Rollin T. Chamberlin, professor of geology in the University of Chicago.

THE honorary degree of doctor of science was conferred on Robert T. Hill on June 4 by Southern Methodist University. This degree was awarded in recognition of more than forty years' service as a geologist in Texas, Cuba, Porto Rico, Panama, the Lesser Antilles and in southern California.

At the fifty-seventh annual commencement of Stevens Institute of Technology, honorary degrees were conferred as follows: Gerard Swope, doctor of engineering; Professor Francis Jones Pond, head of the chemistry department, doctor of science; George Orrok, engineer, the degree of mechanical engineer.

PROFESSOR ALBERT EINSTEIN'S influence on the evolution of the quantum theory was emphasized by the author of the theory, Professor Max Planck, at a meeting of the Berlin Physical Society on June 29 on the occasion of the celebration of the fortieth anniversary of Dr. Planck's entry into scientific work. Dr. Planck presented to Dr. Einstein the first cast of a medal created by the society in his honor.

THE Gold Josef Schneider medal of the University of Würzburg has been conferred on Dr. Robert Doerr, professor of hygiene of the University of Basle.

A LUNCHEON in honor of Dr. Carlos Chagas, formerly director-general of public health in Brazil and now head of the department of hygiene of the University of Rio de Janeiro, was given at the Bankers Club of New York City on June 20. The American Brazilian Association was host at the luncheon. Dr. George E. Vincent, president of the Rockefeller Foundation, paid a tribute to the "great Brazilian scientist who has been of more assistance to the Rockefeller Foundation in South America than any other person." Dr. Sebastiano Sampaio, consul-general of Brazil, followed with a eulogy of Dr. Chagas. Dr. Chagas made a three-weeks' stay in the United States to study American hospitals.

DR. KNUD RASMUSSEN, the Danish Arctic explorer, celebrated in Copenhagen on June 8 the fiftieth anni-

versary of his birth. The day was marked by the receipt of many congratulations, including a message from the Government of Greenland. Dr. Rasmussen marked the occasion by publishing a selection of Eskimo tales and the report of the fifth Thule Expedition.

AN Associated Press despatch states that the Italian Government has conferred a gold medal for civic valor posthumously on Dr. Finn Malmgren, who accompanied the Nobile expedition, and has bestowed a pension of 2,000 kronen (about \$520) annually on his mother. At the same time it is sending to her all the documents of the commission of inquiry into the loss of the dirigible *Italia* and the death of Dr. Malmgren. Premier Mussolini received Dr. Malmgren's sister and accepted her thanks for the government's generosity to the family and the honor bestowed upon her brother.

At the meeting of the Scientific Apparatus Makers of America in Atlantic City, on May 16, 17 and 18, the following officers were elected: President, N. H. Ott, the Spencer Lens Co., Buffalo, N. Y.; vice-president, Carl Amend, Eimer and Amend, New York, N. Y.; secretary-treasurer, J. M. Roberts, Central Scientific Company, Chicago; chairman of the chemistry section, C. G. Fisher, Fisher Scientific Co., Pittsburgh, Pa.; chairman of the physics section, C. A. Bengston, Chicago Apparatus Co.; chairman of industrial instrument section, W. W. Patriek, Foxboro Co., New York, N. Y.; directors at large, M. E. Leeds, Leeds and Northrup Co., Philadelphia; J. Ely, Taylor Instrument Co., Rochester, N. Y.; H. K. Kimble, Kimble Glass Co., Vineland, N. J.; L. C. Irwin, C. J. Tagliabue & Co., Brooklyn, N. Y.

THE officers of the American Geophysical Union and of its sections, following the elections at the tenth annual meeting of the union on April 25 and 26, 1929, whose three-year terms are effective from July 1, 1929, are as follows: *Union*—Wm. Bowie, chairman; L. H. Adams, vice-chairman; (J. A. Fleming, as general secretary continues through June 30, 1931); *Section of Geodesy*—W. D. Lambert, chairman; L. J. Briggs, vice-chairman; H. G. Avers, secretary, to fill the unexpired term of W. D. Lambert from July 1, 1929, to June 30, 1931; *Section of Seismology*—N. H. Heck, chairman; F. Wenner, vice-chairman; (F. Neumann continues as secretary of the section through June 30, 1931); *Section of Meteorology*—G. W. Littlehales, chairman; W. R. Gregg, vice-chairman; O. H. Gish, secretary; *Section of Terrestrial Magnetism and Electricity*—D. L. Hazard, chairman; L. W. Austin, vice-chairman; H. W. Fisk, secretary; *Section of Oceanography*—A. H. Clark, chairman; H. B. Bigelow, vice-chairman; H. A. Marmer, secretary; *Section*

of *Volcanology*—A. L. Day, chairman; R. L. Daly, vice-chairman; C. N. Fenner, secretary.

At a recent election of officers of the American Society of Plant Physiologists for the year 1929–1930, Dr. Scott V. Eaton, of the department of botany of the University of Chicago, was elected president and Dr. Charles A. Shull, also of Chicago, vice-president.

DR. UDO J. WILE, professor of dermatology at the University of Michigan, was elected president of the American Dermatological Association at the annual convention held at Del Monte, California. Dr. E. D. Chipman, of San Francisco, was named vice-president, and Dr. Guy Lane, of Boston, secretary. The association will meet next year in Cleveland.

A DELEGATION of seventeen members has been appointed by President Hoover to represent the United States officially at the World Engineering Congress which will meet at Tokyo on October 29. Members of the delegation from Washington are Commissioner Elwood Mead, George Otis Smith, George K. Burgess, O. C. Merrill, Major-General Edgar Jadwin, Scott Turner and John Hays Hammond. From New York, Elmer A. Sperry, Frank B. Jewett, John W. Lieb, Maurice Holland, Daniel L. Turner, Byron Eldred, J. V. W. Reynders and Mark Requa have been appointed. John R. Freeman, of Providence, and Dugald C. Jackson, of Boston, make up the list.

DR. HARLAN TRUE STETSON, assistant professor of astronomy at Harvard University, has been appointed head of the department of astronomy and director of Perkins Observatory at the Ohio Wesleyan University at Delaware. Dr. Stetson has been a member of the Harvard faculty for thirteen years.

DR. MARCUS BENJAMIN, editor for the U. S. National Museum, has been appointed by the Chemical Society of London to be one of its representatives at the fiftieth anniversary celebration of the foundation of the American Society of Mechanical Engineers, to be held in Washington from April 7 to 9, 1930.

W. K. WILLIAMS, JR., has been appointed extension forester to represent the Forest Service and the Office of Cooperative Extension Work of the U. S. Department of Agriculture in the forestry extension work which the department and the agricultural extension services of the states carry on cooperatively. His appointment became effective on July 1. He succeeds G. H. Collingwood.

DR. J. L. McELROY, following several months given to visiting medical centers of Europe, has become superintendent of the hospitals of the Medical College of Virginia, Richmond. These are the Memorial, the Dooley and the St. Philip hospitals. The Crippled

Children's Hospital is affiliated as the orthopedic department for white children.

DR. W. P. KELLEY, agricultural chemist at the University of California Citrus Experiment Station, has been named chairman of the committee of the American Society of Agronomy on the Chilean Nitrate of Soda Nitrogen Awards, amounting annually to about \$5,000. Dr. Kelley replaces Dr. Oswald Schreiner, of the U. S. Department of Agriculture, who is spending several months in the Far East. The object of the awards is the encouragement of research bearing on the relation of nitrogen to economic crop production.

DR. A. F. JOSEPH, lately chemist for the Sudan government, has been appointed deputy director of the Imperial Bureau of Soil Science, one of the eight bureaus the formation of which was recommended by the Imperial Agricultural Research Conference of 1927. Sir John Russell, director of Rothamsted Experiment Station, is, as already announced, the director of the bureau.

DR. CHARLES S. HOWE, who will retire from the presidency of the Case School of Applied Science the last of August, will make his home in North Amherst, Mass., during the coming college year.

MEMBERS of the faculty of Kansas State Agricultural College who have been granted sabbatical leave for the academic year 1929–30 include Dr. Robert K. Nabours (zoology), Professor W. T. Stratton (mathematics), Professor H. H. Laude (agronomy), Professors T. J. Anderson and R. M. Green (economics), Professor Martha Pittman (food economics and nutrition), and Professor R. G. Kloeffler (electrical engineering).

DR. J. W. GIDLEY, of the division of vertebrate paleontology of the National Museum, has recently returned from Melbourne, Florida, where he continued excavations in connection with his study of the Pleistocene fauna and evidence of early man. Mr. C. W. Gilmore, curator of the same division of the museum, is in charge of a party collecting Upper Cretaceous vertebrates in the San Juan Basin, north-west New Mexico.

DR. C. U. CLARK, formerly assistant professor at Yale University, will undertake for the Smithsonian Institution, beginning in September, research in the archives of Spain with reference to documents and artifacts relating to the aborigines of the Americas and more particularly the Mayas and Toltecs of Central America.

DR. FREDERICK L. HOFFMAN, consulting statistician of the Prudential Insurance Company, is attending the annual meeting of the American Medical Asso-

ciation to read an address on "Some Final Results of the San Francisco Cancer Survey." Dr. Hoffman will also participate in the Pan Pacific Surgical Conference in Honolulu in August and will read a paper on "Cancer in Hawaii," supplemented by an address to be read before the Hawaiian Medical Society on "Race Pathology in Hawaii." While in Hawaii, Dr. Hoffman expects to give particular attention to Asiatic mortality problems.

AN International Radio Conference will be held at The Hague, opening on September 19. An appropriation of \$27,500 has been made by the Congress. Commissioner H. A. LaFount and Captain Guy Hill, chief engineer, will represent the Federal Radio Commission, while other representatives will be chosen by the State Department from the various government departments operating research laboratories. American companies and radio associations desiring to send representatives may do so, and the State Department has asked that it be given their names.

THE non-magnetic ship *Carnegie* left Yokohama on June 24; she is due at San Francisco about July 29. Since the last report in SCIENCE the vessel was at Pago Pago, American Samoa, April 1 to 5, and at Apia, Western Samoa, from April 6 to 20. Passing close to Wake Island May 11, the vessel arrived at Guam May 20. Departure was taken for Yokohama May 25. The oceanographic observations are constantly developing new bottom features; among these was the discovery of a new deep which was named "Fleming Deep" by Captain Ault, the maximum depth recorded being 8,650 meters at 23.°8 north latitude and 144.°1 east longitude. While in Western Samoa and in Japan the magnetic standards of the Apia and Kakioka observatories were compared with those of the *Carnegie*. Exercises commemorative of the twenty-fifth anniversary of the research activities of the Carnegie Institution of Washington are to be held on board the *Carnegie* in San Francisco Harbor on August 26, 27 and 28, just before her departure late in August for Hawaii, Samoa and New Zealand.

THE Royal Agricultural Society of England is offering a medal for original agricultural research, the regulations governing which are as follows: (1) The medal will be called the Royal Agricultural Society of England's Research Medal. It will be of silver, and money or books to the value of £10 will be added. (2) The medal will be awarded for a monograph or essay giving evidence of original research on the part of the candidate on any agricultural subject, on any of the cognate agricultural sciences or on agricultural economics. It must be

signed by the candidate, the genuine work of the candidate himself. (3) Candidates for the medal must reside in Great Britain or Ireland, and must not be more than 30 years of age on September 29, 1929. (4) The medal will be adjudged by referees appointed by the council of the Royal Agricultural Society. (5) The monograph or essay must be forwarded to the secretary of the Royal Agricultural Society on or before October 31, 1929. The monograph or essay must be typewritten or printed. (6) If, in the opinion of the referees, no monograph or essay be found to attain a sufficient standard of excellence, they shall be at liberty to reserve the medal of that year for award as an additional medal in some subsequent year. (7) The monograph or essay of the successful candidate shall be published in the *Journal* of the Royal Agricultural Society, if, in the opinion of the Council, it is suitable for that purpose. Essays already published shall not be eligible for the medal.

At the recent annual dinner in London of the Royal Geographical Society, the president, Sir Charles Close, reported that a new lecture hall and library were being erected at the headquarters of the society at Kensington-gore. When these buildings were completed the society would, for the first time in its long existence, possess a lecture theater of its own and a properly designed library. The lecture theater would seat 850 people, and arrangements were being made for the display, when necessary, of moving pictures for the illustration of travelers' lectures. The books of the society, which constituted a magnificent collection, were at present distributed in passages and rooms, and even in cellars. In the new library the books would be brought together and room would be available for the collection of maps, which was said to be the finest unofficial collection in the world. The scheme was estimated to cost about £50,000. Towards that sum the society had available, including the amount received from the disposal of their surplus land, about £44,000.

THE first of a contemplated series of reports which will contain abstracts of current articles and publications dealing with applied geophysics has been issued by the U. S. Bureau of Mines, Department of Commerce. The abstracts will be prepared, for the most part, by officials and engineers of mining and exploration companies in cooperation with the Bureau of Mines. It is believed that useful and timely information dealing with the science of applied geophysics can thus be adequately presented. The bureau plans, if possible, to procure the original papers from which these abstracts are prepared and to assist those who may be interested in obtaining translations or photostat copies. The bureau has obtained the cooperation of twenty-five well-recog-

nized experts as contributing editors to this series of geophysical abstracts. Information Circular 6,120, which has been compiled by Frederick W. Lee, supervising the Geophysical Section, U. S. Bureau of Mines, contains abstracts of papers dealing with gravitational, magnetic, seismic, electrical, radioactive, geothermal and various unclassified methods. Most of the papers abstracted were published in Germany and Russia.

As a result of a request from the War Department, the chief coordinator of the Bureau of Standards has arranged for the preparation by the bureau of a classified list of all governmental laboratories, facilities, etc., available for the testing of supplies and materials for the purchasing officers of the various government departments. "The Directory of Governmental Testing Laboratories" will supplement "The Directory of Commercial Testing and College Research Laboratories" (Bureau of Standards Miscellaneous Publication No. 90), now in its second edition. Information will be given concerning not only the kinds of commodities which each laboratory can test, but also the types of testing equipment in each laboratory, and the routine procedure involved in obtaining authority for the laboratory to assist purchasing officers in making tests and furnishing results relating thereto.

THIRTEEN countries in Central and South America have promised cooperation in the world agricultural census of 1930, L. M. Estabrook, director of the census for the International Institute of Agriculture, stated June 21. Mr. Estabrook has just returned to

Washington from a 11,000-mile trip to the capitals of Guatemala, Salvadore, Honduras, Nicaragua, Costa Rica, Panama, Ecuador, Colombia, Venezuela, British Guiana, Trinidad and Barbados. The inclusion of these countries in the census brings the total representation in the project to about 97 per cent. of the land surface, 98 per cent. of the total population and approximately 99 per cent. of the total agricultural production of the world. The undertaking of a world census of agriculture in 1930 was approved by the General Assembly of the International Institute of Agriculture at Rome in 1924, and the preliminary work of organizing the census was made possible by the cooperation of the International Educational Board, the U. S. Department of Agriculture and the International Institute of Agriculture. The census program and standard form of census questionnaire have been approved by the permanent committee and two general assemblies of the institute, by the Diplomatic Conference on Economic Statistics that met in Geneva in November, 1928.

W. L. G. JOERG, secretary of the advisory committee of the American Geographical Society, calls attention to the fact that the notice appearing in the June 21, 1929, issue of SCIENCE under the title "The Settlement of the Undeveloped Areas of Canada" implies that the American Geographical Society has assumed the cost. The society (with the aid of an advisory committee) is responsible only for the prosecution of the work and not for financial support. The funds are provided by the Social Science Research Council.

UNIVERSITY AND EDUCATIONAL NOTES

By the will of the late Charles B. Swift, of Detroit, Middlebury College receives a bequest of \$200,000.

EDINBURGH UNIVERSITY has received gifts for the reconstruction of the medical buildings at Teviot Place, Edinburgh, of £20,000 from the trustees of the late Sir William Dunn and £35,000 from the Rockefeller Foundation. This, with other sums now available, secures the carrying out of a scheme whereby the buildings, which were erected in 1880, will be reconstructed to bring them into conformity with the requirements of modern teaching and research.

DR. HAROLD A. IDDLIS, of Columbia University, has been appointed head of the department of chemistry of the University of New Hampshire to fill the vacancy caused by the death of Professor Charles James.

JOHN FRANKLIN DODGE, fuel oil engineer of the Standard Oil Company of California, has been named

professor of petroleum engineering in the college of engineering of the University of Southern California.

DR. ALLEN T. NEWMAN, dean of the school of dentistry at the University of Denver, has resigned to accept a similar appointment at New York University to succeed the late Holmes C. Jackson.

DR. W. T. ROOT, professor of psychology in the University of Pittsburgh, has become head of the department of psychology to succeed Dr. J. H. White.

DR. WILLIAM S. SCHLAUCH, chairman of the department of mathematics of the High School of Commerce of New York City, has been appointed assistant professor at New York University.

At the University of Liverpool, C. C. Titmarsh, reader in mathematical analysis in the University of London, has been appointed professor of pure mathe-

matics, and Dr. J. H. Orton, chief naturalist at the Plymouth Marine Biological Laboratory, has been appointed Derby professor of zoology. Dr. D. B.

Blacklock, professor of tropical diseases of Africa in the university, has been made Walter Myers professor of parasitology.

DISCUSSION

BIOLOGICAL CONTROL OF THE PRICKLY PEAR IN MADAGASCAR

THE recent accounts in SCIENCE of prickly pear control in Australia have dealt with the problem only from the standpoint that the complete eradication of this pest is an unmixed blessing. However true this view-point may be for most places in the world, in the south of Madagascar the destruction of the *raketa* by a cochineal insect (*Coccus cacti*) is being looked upon both by the natives and the Europeans as a calamity.

What are the conditions in the south of Madagascar that make it unlike the rest of the world, differing from the territory a few miles to the north where the disappearance of the prickly pear has been witnessed with acclaim? M. Decary, for many years a French official in southern Madagascar, and a botanist of note, has called attention¹ to the dependence of the Antandroy natives upon the *raketa*, quoting a local proverb to the effect that "The *raketa* and the Antandroy are inseparable," and going so far as to say that without the prickly pear there could have developed no Antandroy tribe!

Certainly this plant has its undesirable features, but to these people it is not only endurable, but essential; it furnishes food and drink for man and beast in this desert region, and these at the time of year when they are most necessary. Among other things it also provides impenetrable barricades around the cultivated fields, the livestock corrals and the villages.

Some years ago, before the appearance of the cochineal insect, a partially successful attempt was made to introduce *Opuntia inermis* into this region to replace the thorny types (*O. dillenii* and *O. ficus-indica*) which, during the last two centuries, have become the commonest plants in this region. Although *O. inermis* is immune to the attacks of the insect, one of the cultural requirements for its establishment has been a barrier of the thorny type sufficient to keep out the livestock; hence the destruction of the immune species is indirectly being brought about by the destruction of the species actually susceptible to the insect.

I can not offer any direct testimony as to the exact nomenclature of the causal insects; however, I can vouch for the thoroughness of the destruction now

being wrought. Our party marched for days through country where, a few months before, the commonest plant had been the fifteen-foot-high prickly pear, now all completely destroyed; very rarely we would see a weak shoot, six inches high, which had come up from the root and which was also rapidly being destroyed. If such complete eradication could be effected in Australia and other places where the presence of *Opuntia* is not desired, in a few months the prickly pear would cease to be a problem.

CHARLES F. SWINGLE

BUREAU OF PLANT INDUSTRY,

U. S. DEPARTMENT OF AGRICULTURE

HORSES, DOGS AND CATS

IN a recent number of SCIENCE (May 10, p. 494), Professor W. D. Matthew objects to my using the horses as an example of "linear evolution involving a time element." But he admits, apparently in connection with horses, that:

We can and do have, in many cases, a succession of collateral ancestors so nearly related to the direct genetic line as to afford, when critically studied with due recognition of their status, a clear record of the physical evolution of the race, sometimes in more general, sometimes in more detailed terms, according to the nearness of their approximation to the direct ancestral line.

This "direct ancestral line" from *Eohippus* to *Equus* was precisely the line to which I referred. He therefore himself predicates its existence, and admits that it involves a time element. He says that in the case of the phylogeny of the horses the "analogy to the growth of a tree is a sound and a real one." No one doubts this. But does not the trunk of the tree run from *Eohippus* at the base to *Equus* at the summit?

He regards my statement that "the gap between cats and dogs is broad, and it remains broad throughout the fossil record" as misleading. However, he says

No one, so far as I know, ever suggested that cats became dogs or dogs cats . . . but it has been believed that these two diverse families of Carnivora are descended from the primitive Carnivora (Miacidae) of the Eocene epoch.

I said that both cats and dogs are carnivorous mammals, expecting that zoologists would understand

¹ Bull. Economie Madagascar, 1927 (1); Rev. Bot. App. No. 50, 1925, and No. 77, 1928.

that this presupposed descent from an ancestor common to these two groups in the Carnivora. He says that my statement "is evidently intended to give the impression that the 'gap' between them is not reduced as we trace them backward. That is very far from being correct." I never said or implied anything about the gap not being reduced; I said that it remains broad, and that "cats never became dogs nor dogs cats"—and they never did. This he admits.

He mentions my "new" theory of evolution with no explanation of the quotation marks. I never said it was new. What I said was that "It is rather a harmonizing of previous theories than a new idea; but parts of it [concerning the interrelationships of the phyla] are wholly new." This statement is absolutely correct. He adds that "the idea of separate origins of the major phyla of animal life [just what are major and minor phyla?] was a commonplace when I went to college in the late eighties, and still remains an open question, so far as I know." This gives a totally erroneous impression of my viewpoint. I traced all the phyla to a *common*, not to a *separate*, origin. Had he taken the trouble to read what I wrote in the paper to which I referred in a foot-note he would have discovered that I had offered a solution to the problem that so worried Professor Meckel in 1811 and interested him in the late eighties.

Lastly he says that my statements seem to him "gravely misleading as to the actual facts of phyletic evolution, although worded in so vague a way as usually to escape being absolute misstatements."

I would like to see Professor Matthew, or any one else, formulate general statements concerning phyletic evolution which will be equally applicable to crustaceans, insects, mollusks, vertebrates and other types of animal life and at the same time will not be "vague" when considered as a detailed exposition of the case in any single phylum or part of a phylum.

If Professor Matthew will point out a group of well-known creatures which demonstrate the principles of an evolutionary line or tree better than the horses, and another group of well-known animals that show systematic isolation better than the cats, we shall all be very grateful for the information. And if he will go further and arrange all the phyla in such a way as to combine a common origin and simultaneous development more logically than my scheme does he will have performed an outstanding service.

Until that time I can not see that he has any valid reason for dissenting from what I said regarding evolution.

AUSTIN H. CLARK

U. S. NATIONAL MUSEUM

ATMOSPHERIC ELECTRICITY

I WAS much interested in the account of the generation of static electricity in sand-storms, given by Mr. R. H. Canfield in *SCIENCE* for May 3, 1929.

On the night of April 30 I camped on the desert near Yuma, Arizona, with a companion; I slept on a cot while he occupied a mattress on the ground. During the night a sand-storm came up with a rather high wind. Being unable to keep control of the bedclothes on the cot, I moved into the car, which had an all-steel body, for the night.

Upon arising in the morning and touching the car, my companion received a rather painful spark from it, and this was repeated several times in the next few minutes. The storm meantime had blown out. There was no effect whatever so far as I was concerned.

A partial theory to account for this would be that the car body became charged with static of opposite sign to that of the ground; that my companion had a skin charge of the same sign as that of the earth and myself the same as of the car body, and that the potential naturally equalized when he touched the car. If this is true, however, I should have noted a spark between myself and the ground on getting out, but did not.

The unrest noted by Mr. Canfield is a very marked symptom in all the sand-storms I have experienced, and in some of them I have been inside sand-tight quarters and in a comfortable bed. On the other hand, I have slept in high winds unprotected, or in sandy blankets, without feeling particular discomfort—certainly not the same kind of discomfort.

This appears to be a subject which needs elucidation and experimentation, the results of which might be of more importance than may appear at first sight.

VICTOR A. ENDERSBY

R. H. CANFIELD's article in the May 3 issue of *SCIENCE* on "Atmospheric Electricity During Sand Storms" brings to mind some accidental observations made by the writer in the late winter of 1919, which may be of some interest.

The writer was installing a wireless receiving set in his house in Boston, Massachusetts. Upon accidentally bringing the lead-in wire into close proximity with the ground connection, a strong spark was observed to jump between the two conductors. Two wires were arranged and varied until the maximum distance the spark would jump was found. This turned out to be about one centimeter. Thereafter sparks would jump at intervals of about two seconds with extreme regularity. The discharge began as a

slight hissing noise, gradually increasing in intensity and culminating with a sharp crack and a flash of blue light. The whole was strongly suggestive of the gradual charge and sudden discharge of a condenser. Observations were not made continuously, the writer being mainly interested in the installation of his radio, but five or six successive trials showed the phenomenon to last apparently continuously for a period of about four hours, from about four o'clock in the afternoon until about eight in the evening, well after nightfall.

The antenna was four-stranded, about one hundred feet long, of solid aluminum wire, and strung about ten feet above a thirty-foot house, the roof of which was of copper and grounded. The sky was overcast at the time; there was no wind and the atmosphere was heavily charged with moisture. The time of year was not one in which there are electrical disturbances in that locality, nor did any electrical storm precede or follow the observations for a period of many weeks.

The writer explained the phenomenon at the time as due to the gradual leakage of electricity from a highly charged layer through the moist air to the ground. The conducting antenna, being in an area of slightly higher potential, became gradually charged with respect to the ground. When this charge reached a sufficient magnitude, a brush discharge set in across the gap, increasing in intensity as the charge increased until it was able completely to overcome the resistance of the gap, when the whole escaped to the ground with the accompanying spark. The process was then repeated at a rate proportionate to the rate of leakage through the air.

DUNCAN G. FOSTER

SWARTHMORE COLLEGE

EDUCATIONAL SCIENCE!

DURING the last few days the freshmen in the college of arts and science at the University of Pennsylvania have been subjected to a series of achievement tests as part of the Pennsylvania state survey of relationship between secondary schools and colleges. This

survey is in charge of the Carnegie Foundation for the Advancement of Teaching in cooperation with the College President's Association of Pennsylvania and the Pennsylvania State Department of Education. Similar tests were given to all freshmen in many other colleges and universities in the state.

Among the tests given was the Columbia Research Bureau Plane Geometry Test by Herbert E. Hawkes, Ph.D. (professor of mathematics and dean of Columbia College) and Ben D. Wood, Ph.D. (associate professor and director of Bureau of Collegiate Educational Research, Columbia College, Columbia University). Test Form B for High Schools and Colleges was employed in this examination. Part II is concerned with problems. A sample problem is worked out at the top of the page. This reads: "Sample. How many degrees are there in four right angles?—(180)." There is no chance of this being a printer's error inasmuch as "four" is printed out and the "180" is printed in script.

What I wish to raise is the question of marking the thirty-five problems involved in this part of the paper. The sponsors of this examination gave no instructions with regard to this error, hence we may suppose that it must be taken at its face value as a sample. This implies that all truly correct answers to the problems must be marked as incorrect! That is obvious. But what is to be scored as correct is not so apparent. Two possibilities present themselves: (1) All truly incorrect answers should be scored as correct; or (2) all correct answers must be divided by two in order to receive credit.

But seriously it seems inexcusable to me that such an error should not have been caught by either the authors or the publishers, especially when one considers that this alleged measuring instrument carries the copyright date of 1926. And the directions printed just above the sample question say in part: "This means that you must *check your arithmetical operations carefully* before putting down an answer." (Italics theirs!)

SAMUEL W. FERNBERGER

UNIVERSITY OF PENNSYLVANIA

SPECIAL CORRESPONDENCE

THE RECENT BONE-CAVERN FIND AT BISHOP'S CAP, NEW MEXICO

It seems desirable at this time to make a brief preliminary announcement of what is believed to be an unusually significant bone-cavern find recently made in the lower slope of Bishop's Cap Peak in southwestern New Mexico by Mr. Roscoe P. Conkling, of El Paso, Texas.

Mr. Conkling, who for many years has been connected with the American Smelting and Refining Company, has had as a form of relaxation and recreation a very lively interest in the field study of archeology, coupled with a general interest in natural history, which in the course of his travels in connection with mining operations in remote fields has led him to examine and to study scores of burial

and bone caves in America and in various foreign lands.

In following this interesting avocation, he some time ago arranged with Nicanor Mestes, Richard Chapman and José M. and Lorenzo Benavidas to locate promising caves within reach of El Paso for him to leisurely explore and study. Their acquaintance from youth with the mountains in the country surrounding El Paso and the first-hand knowledge of a local tradition to the effect that Spanish gold had long ago been buried in the small dark cave on Bishop's Cap Peak prompted them, under Mr. Conkling's encouragement, to go there and dig—not for bones or Indian relics, but for buried treasure—with the happy result that in this indirect manner what appears to be an exceedingly important and convincing discovery in the prehistory of America has been made.

The cave, which is located in carboniferous limestone, opened on the easterly flank of the mountain through a jagged orifice about three by four feet (since enlarged) which led into a dark stone cavern formed by water erosion. The floor was about eight feet below the mouth and was of wind-blown sand some twenty feet or more in irregular diameter. Aside from a few unsuccessful attempts to use the cave as a storm-shelter by an occasional herder, the place had never been a human habitation. A previous unsuccessful attempt to locate treasure in this cavern was made about forty years ago by men still living, who since the discovery have been induced to revisit it.

The work of treasure hunting proceeded without much show of success until at a depth of approximately ten feet below the floor bones were unexpectedly discovered. These were thought by the excavators to be perhaps the bones of a mule that might have belonged to the owners of the supposed buried treasure. As a result the work of excavation went feverishly on, until a fragment of a human skull was exhumed! These bones were brought to the attention of Mr. Conkling, who at once recognized the possible importance of such a find under such circumstances. He then took active charge of the excavations and carefully supervised the further exploration of the cavern.

Early in the work he sent photographs and drawings of his finds to the Los Angeles Museum for verification, with the result that Dr. Chester Stock, curator of the department of vertebrate paleontology, identified certain of the bones uncovered under ten feet of sandy loess deposits as the well-preserved phalanges of a ground sloth; and, as these were found adjacent to and at the same depth as the human skull cap referred to, all excavations since have been made with a view to preserving all available data growing

out of the association of the material uncovered, as well as the material itself.

The cavern during the past four months has been carefully excavated to a depth of more than thirty feet without encountering rock bottom, the inference being that it extends much deeper. Except for a slight amount of surface material, and material doubtless falling down from the roof, the entire space is uniformly filled with very fine reddish wind-blown sand which exhibits an ill-defined horizontal laminated bedding, indicating the nature of its slow accumulation.

Eight feet below the occurrence of the skull, *i.e.*, twenty feet below the surface, a hard, compact lens from two to four inches in thickness was encountered. This, while composed of the same material as that which filled the cavern, differed in that it was evidently water laid. Apparently it had settled out of water accumulated in the cavern, as a result perhaps of a cloudburst. The value of this circumstance, however, lies in the fact that it formed a definite undisturbed horizontal diaphragm completely flooring up the cave. The significance of this will be appreciated when it is understood that at about eighteen inches below this floor and more than twenty-one feet below the surface floor of the cavern additional human skull fragments were found!

From the twelve-foot level where the first skull was found, to the bottom of the excavation, *i.e.*, for a depth of eighteen feet, bones of extinct horse, cave-bear, camel and sloth have been excavated in such numbers as to fill five large table type museum exhibition cases, while a bushel or more of small animal and bird bones have been recovered. Practically the complete skeleton of a ground sloth was found in place midway down between the occurrence of the two skull finds, which were almost ten feet apart. The last bones recovered from the bottom of the excavations were the limb bones of a very large camel!

From the foregoing it would seem obvious that we have here the undisturbed occurrence of human remains in direct association with a number of animals regarded as extinct since the Pleistocene period, and all deposited in such a manner as to preclude even the suggestion of their later intrusive burial. It is, therefore, believed that the Bishop's Cap bone-cavern has been a den and trap for wild animals through countless centuries and is a find which fortunately settles conclusively the moot question as to whether man and the sloth, the camel and the cave-bear, for example, were coexistent in America.

At the invitation of Mr. Conkling, the writer visited the cavern during the latter part of April. After very careful study of the occurrence and having had the exhilarating satisfaction of assisting in the re-

moval of the pelvic and lumbar portion of the sloth specimen referred to and seeing its relation to the human remains, I do not hesitate to pronounce the find as probably the most important prehistory discovery ever made in America.

Through the courtesy of Mr. Conkling, the Los Angeles Museum has been made the repository for all the material recovered. The specimens may now be seen in Los Angeles. The museum has also been given charge of the cavern by its discoverers and will continue the excavation and study of the occurrence.

A number of competent geologists have already examined the deposit and are unanimous in their appreciation of its authoritative, far-reaching significance. While the cavern will not be open to the public, for obvious reasons, during its continued study, qualified investigators will be welcome to examine both the material and the occurrence, but should arrange with the Los Angeles Museum in advance in order that proper facilities can be arranged.

WM. ALANSON BRYAN

LOS ANGELES MUSEUM

SCIENTIFIC BOOKS

Statistical Mechanics. By R. H. FOWLER. 570 pp. Cambridge University Press. 1929. (New York, The Macmillan Company.) 35 shillings.

THE subtitle of this monumental book is "The Theory of the Properties of Matter in Equilibrium," and this is a fairly descriptive characterization of the wide range of phenomena which it covers. Any number of books have been written on the application of modern physics to individual atomic systems, especially on the quantum theory of spectroscopy. There has, however, been a dearth of up-to-date literature on the statistical properties of an assembly of an enormous number of atoms or molecules. Such properties embrace a wealth of phenomena of great interest to the physicist, mathematician, astronomer and chemist. Of course there are standard classical treatments of statistical mechanics, notably those of Gibbs, Boltzmann, Jeans and Ehrenfest, but these use only the pure classical theory. The introduction of the modifications required by modern quantum theory is not merely necessary to secure agreement with experiment, but also is vital for logical consistency, as the negatively infinite potential energy at coincidence of a proton and electron makes the classical Boltzmann distribution formula inapplicable to any real atomic system. Professor Fowler has done wisely to introduce the quantum theory at the very beginning, and to regard classical theory as a limiting case thereof, rather than to adopt the too common procedure of adding on quantum modifications as a non-descript appendage of an otherwise classical treatment. In short, he has done a great service in writing a quantum statistical mechanics more comprehensive than the existing books by Herzfeld, Smekal and Uhlenbeck.

When the reviewer is confronted with the prospect of appraising the 570 large pages of this book, with their 1,607 numbered equations, he feels that he has set himself a Herculean task. His only consolation is how infinitely much more of an ordeal it must have

been for Professor Fowler to write the book itself. Even though in the preface Professor Fowler acknowledges the aid of many collaborators, one still is astonished at the accuracy and thoroughness with which he has handled a tremendous diversity of physical, chemical and astronomical phenomena.

After an introductory chapter, the second chapter develops the mathematical scheme which is the backbone of the whole book. This is the derivation of the Maxwell-Boltzmann distribution formula by an ingenious and elegant method which was originally given by Darwin and Fowler in the *Philosophical Magazine* and which should especially interest mathematical readers. In evaluating the sum of factorial products encountered in statistical mechanics, the common procedure is to resort to Stirling's theorem, thereby introducing an approximation whose degree is a bit obscure. Instead, Darwin and Fowler identify this sum with a certain coefficient in a multinomial expansion and evaluate this coefficient as a contour integral by means of the residue theorem of complex variable theory. The integrand is large only in the vicinity of a "col," and so the integral can be evaluated by the method of steepest descents. The average properties of an assembly in the sense of averages over the phase space can thus be calculated. Both as regards physical significance and mathematical rigor, it is far more satisfactory to use such an average property than the "most probable property" so frequently encountered in elementary books on statistical mechanics. In statistics a property which is the most probable has little significance unless it is infinitely the most probable; i.e., what Jeans terms a "normal property." Otherwise it might, loosely speaking, be likened to a weak plurality rather than a dominating majority in an election. To be truly representative, a property must be shown to be normal rather than merely the most probable. Even the average properties are not necessarily the normal ones, and it is only when one calculates the fluctuations, as is done in the

next to the final chapter of the book, that one can feel sure they are the same. Professor Fowler uses the term normal property in the sense of a time average property of the system rather than in Jeans' sense of a property which holds in all but an infinitesimal fraction of the phase space. The reviewer inclines towards the Jeans definition, as the two definitions are not the same if nature has some peculiar preference for a diminutive fraction of the phase space, something which statistical mechanics can never rigorously disprove. Even Professor Fowler shows a slight tendency to follow in the path of most writers on statistical mechanics, and dismisses just a bit glibly the passage from mathematical space averages to physical time averages. Following the Darwin-Fowler method, Professor Fowler always uses the micro-canonical or rather surface ensemble instead of the full Gibbs canonical one, and the reviewer agrees entirely with Fowler's statement that this procedure seems physically much the more natural and illuminating, even though the Gibbs method has certain mathematical advantages.

After development of the mathematical framework, the succeeding chapters are devoted to various physical applications: the specific heats of gases, the simple properties of crystals, evaporation and dissociative equilibrium, the relation of the equilibrium theory to classical thermodynamics, Nernst's heat theorem and chemical constants, the dielectric and paramagnetic susceptibilities of gases and the properties of solutions, including the Debye-Hückel theory. There are three very complete chapters on the theory of imperfect gases and interatomic forces, written with the collaboration of J. E. Lennard-Jones, whose fundamental work on the relation of the equations of state of gases and crystals is classic.

Considerable space is given to the application of the equilibrium theory to astronomical problems. In fact, the whole book is the outgrowth of Professor Fowler's receipt of the Adams prize in 1923-1924 for his essay on the physical state of matter at high temperatures. It is well known that the development of a stellar temperature scale by application of the quantum theory of the excitation of spectral lines is one of the important advances of the century in astrophysics. The harder a spectral line is to excite, *i.e.*, the higher the quantum energy levels involved, the hotter a star must be for such lines to appear. Only the hottest stars, for instance, display the lines of ionized helium. This field of work was opened by Saha, but has been greatly enriched by the contributions of Fowler and Milne, who substituted the so-called method of maximum intensities for that of marginal appearances. The escape of molecules from an upper atmosphere is treated much more thoroughly than usual. Stellar interiors are discussed to some

extent, but Eddington's theory is omitted to avoid duplication with the latter's book.

The chapters on collision processes, chemical kinetics in gaseous systems and radiative processes should interest physical chemists concerned with uni- and bi-molecular reactions, photochemistry, etc. It is gratifying to have this discussion of mechanisms of interaction, even though they are, strictly speaking, not an immediate part of the statistical theory of equilibrium, which arrives at the final equilibrium concentrations without specializing the mechanism.

The final chapter is on the new statistical mechanics of Fermi-Dirac and Einstein-Bose, and enters more fully into quantum mechanics than elsewhere. The treatments in the preceding chapters have been from a standpoint appropriate to the old quantum theory, and the effect of the new mechanics has been regarded as merely to change the energies of the quantized states. This is legitimate in statistical problems except at such low temperatures or high densities that degeneration effects become important. In the preface, Professor Fowler states that the plan of the book was satisfactory at its inception in 1926, but not at its appearance in 1929, due to the development in the meantime of the new quantum mechanics. In our opinion he is too apologetic, for practically the degeneration is important only in rather abstract radiation theory and especially in the electron theory of the conductivity and related properties of metals. The important advances in the latter theory made by Sommerfeld and others are reviewed in the final chapter. In our opinion, other subjects, in which the degeneration does not appreciably enter, are more easily presented without the Fermi-Dirac or Einstein-Bose complications, and so we do not especially regret that they could not be woven into the earlier chapters. On the other hand, some discussion of the Thomas-Fermi atomic force fields, which involve a curious intermingling of classical theory and the new statistics, would have been welcome. It is to be clearly understood that although the new statistics are not explicitly introduced in earlier chapters, the results of the new quantum mechanics are throughout utilized in a descriptive way. Hence practically all the book is very up-to-date. This must have necessitated a tremendous amount of revision during the writing or proof-reading. The theories of dielectric constants, paramagnetism and the specific heat of hydrogen are, for instance, profoundly modified and improved by including, as Professor Fowler does, the results of the new quantum mechanics.

In closing we may caution that Professor Fowler's style, though clear and accurate, is not an elementary one. Without conciseness, incorporation of so much material in one volume would have been out of the question. The book is intended presumably as a

treatise and compendium for readers having a fairly comprehensive physical and mathematical background rather than as an introductory text. On the other hand, a knowledge of the technique of the new quan-

tum mechanics (matrices, "Eigenwert" theory, etc.) is unnecessary.

J. H. VAN VLECK

UNIVERSITY OF WISCONSIN

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A METHOD FOR COMPARING THE VALUE OF AMMONIA NITROGEN AND NITRATE NITROGEN¹

IN a series of experiments, cotton plants² were grown in two nutrient solutions of practically identical chemical composition but only different in the sulphate ion concentration and form of nitrogen. One solution contained only ammonia nitrogen as diammonium hydrogen phosphate and ammonium sulphate; the other solution contained only nitrate nitrogen as potassium nitrate, as source of readily available nitrogen. The hydrogen ion concentration was adjusted in each solution to give a maximum yield of dry matter, and the hydrogen ion concentration of the nutrient solutions was then kept constant by mechanical stirring, by aeration and by constant solution renewal. A rate of flow of 1.4 cc per minute per plant was found sufficient for maintaining the hydrogen ion concentration of the solution practically constant around the roots of the cotton plants up to an age of six weeks.³

Experiments are now in progress to determine the maximum growth with minimum salt concentration (or osmotic pressure) using the salts given in the solution mentioned in this article.

Johnston and Hoagland maintained a rate of flow of 8 cc per minute per plant when growing tomato plants.⁴

Besides being practically identical in chemical composition, easily buffered by phosphates and nitrogen compounds, and a constant supply of nutrient solution to the roots, these solutions are easily prepared. By simply adding ammonium hydroxide or potassium hydroxide to the monocalcium phosphate in the solution, diammonium hydrogen phosphate and dipotassium hydrogen phosphate⁵ are formed.

A mixture of monocalcium phosphate, dicalcium phosphate and dihydrogen potassium phosphate is

formed in one case, and monocalcium phosphate, diammonium hydrogen phosphate and dicalcium phosphate in the other. The composition of the solutions in volume-molecular proportions is as follows:

Ammonia Nitrogen Solution	Nitrate Nitrogen Solution
Ca(H ₂ PO ₄) ₂ 0.0010	Ca(H ₂ PO ₄) ₂ 0.0010
(NH ₄) ₂ SO ₄ 0.00575*	KNO ₃ 0.0120
NH ₄ OH 0.0005*	KOH 0.0005**
MgSO ₄ 0.0020	MgSO ₄ 0.0020
K ₂ SO ₄ 0.0070	K ₂ SO ₄ 0.00075**

* These can be varied according to optimum hydrogen ion concentration.

** Varied to obtain maximum yield of dry matter.

The hydrogen ion concentration of the above solutions was pH 5.8. The osmotic pressure of the above solutions is approximately one atmosphere. Iron as ferrous sulphate was added as needed to keep plants green. By varying the amount of ammonium or potassium hydroxide the hydrogen ion concentration can be varied from pH 3.8 to above a pH of 6.5.

The salts formed by the addition of NH₄OH and KOH given above make these solutions contain:

Ammonia Nitrogen Solution	Nitrate Nitrogen Solution
Ca(H ₂ PO ₄) ₂ 0.00075 m	Ca(H ₂ PO ₄) ₂ 0.00075 m
(NH ₄) ₂ HPO ₄ 0.00025	K ₂ HPO ₄ 0.00025
CaHPO ₄ 0.00025	CaHPO ₄ 0.00025
(NH ₄) ₂ SO ₄ 0.00575	KNO ₃ 0.01200
MgSO ₄ 0.00200	MgSO ₄ 0.00200
K ₂ SO ₄ 0.00700	K ₂ SO ₄ 0.00075

The maximum yield obtained from the ammonia-nitrogen solution at various hydrogen ion concentrations was compared with the maximum yield of dry matter of the plants harvested from the solution containing only nitrate nitrogen at various hydrogen ion concentrations. Thus a comparative value was obtained for ammonia nitrogen and nitrate nitrogen.

The following are identical with the above nutrient solutions with respect to the nutrient chemical elements with the exception of the sulphur content and containing mixtures of ammonia nitrogen and nitrate

¹ Published with the approval of the director of the Georgia Experiment Station as paper No. 29, Journal Series.

² The results will be reported in another article.

³ J. W. Shive and A. L. Stahl, "Constant Rates of Continuous Solution Renewal for Plants in Water Cultures," *Bot. Gaz.*, 84: 317-323. 1927.

⁴ E. S. Johnston and D. R. Hoagland, "Potassium Required by Tomato Plants," *Soil Sc.*, 27: 89-109. 1929.

⁵ D. E. Priyanishnikov and M. K. Domontovitch, "The Problem of a Proper Nutrient Medium," *Soil Sc.*, 21: 327-348. 1926.

nitrogen. These solutions contain the following chemical compounds in volume-molecular proportions: mono-calcium phosphate, ammonium hydroxide, ammonium sulphate, potassium nitrate, magnesium sulphate and potassium sulphate. For 25 per cent. nitrate nitrogen, .0010, 0.0005, 0.00425, 0.0030, 0.0020 and 0.00575 respectively; for 50 per cent. nitrate nitrogen, 0.0010, 0.0005, 0.00275, 0.0060, 0.0020 and 0.00425 respectively; for 75 per cent. nitrate nitrogen, 0.0010, 0.0005, 0.00125, 0.0090, 0.0020 and 0.00275 respectively. The hydrogen ion concentration of these solutions can also be varied by varying the amounts of ammonium hydroxide and ammonium sulphate.

WILLIAM G. FRIEDEMANN

GEORGIA EXPERIMENT STATION

A NEW TYPE OF RESPIRATION CHAMBER

IN connection with the cold storage investigations which have been carried on by the pomology section of Iowa State College considerable study has been devoted to the respiratory activity of fruit held under various conditions of maturity, humidity and temperature. In the past, the respiration chambers which were used consisted of desiccators, bell-jars, Bruehl receivers and galvanized iron containers. None of these was entirely satisfactory. A review of the literature on respiration also showed that respiration chambers used by other investigators were often a source of error due to lack of capacity or efficiency.

The respiration studies which were to be carried on during the apple storage season of 1928-1929 demanded the use of a glass chamber of large capacity. Glass was essential for observation of the progressive development of various storage troubles. Correspondence with a number of manufacturers brought forth the information that suitable chambers of about five-gallon capacity with necessary tubulatures, lid openings and ground glass seals could be made for about \$100 a dozen provided a mold was constructed at an additional cost of \$100 to \$150. It can be readily seen that the above figures made the cost almost prohibitive for extensive work with a limited current expense budget.

Finally the writers discovered in a grocery store a wide-mouthed five-gallon pickle bottle which looked promising. Bottles of this type were finally purchased at a price of \$2 each. The pickle bottle was transformed into an efficient respiration chamber by making certain alterations as shown in Fig. 1. A hole large enough to insert a No. 10 rubber stopper was cut through the lacquered metal lid. In order to prevent the sharp edges from cutting into the stopper a metal collar was soldered around the opening as

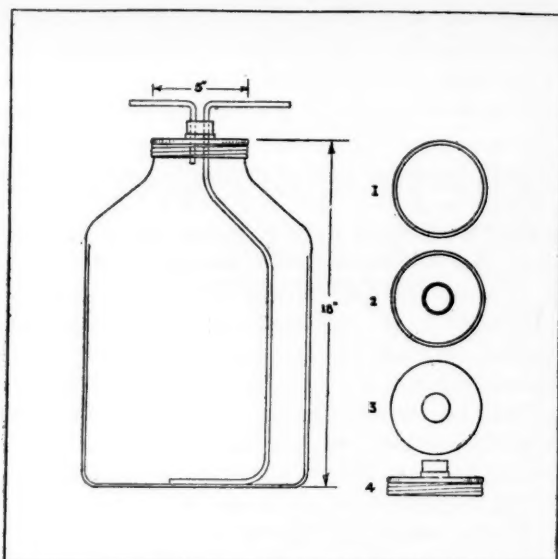


FIG. 1. Details of respiration chamber as developed from five-gallon pickle jar.

shown in No. 4, Fig. 1. The lid was made air-tight with a rubber gasket cut from 1/16-inch sheet rubber packing. This gasket was glued to the inner surface of the lid with tire patching cement. Then when a rubber stopper was inserted into the openings and the lid screwed down tightly repeated tests showed that the bottle was air-tight. As an extra precaution a heavy coating of vaseline was always applied to the edges of all openings when the bottles were in use. The suction connections were made from 1/4-inch copper tubing and were installed as indicated in Fig. 1. The tube which took the carbon dioxide-laden air from the bottom of the chamber was bent to the shape of the side of the bottle in order to facilitate the insertion and placing of the material to be studied.

The most important feature of the pickle bottle was the five-inch mouth opening which permitted easy insertion of the hand and arm for the proper placing of the fruit or other materials. When used as a container for apples, the chamber held about seventy 2 3/4-inch to 3-inch specimens, or approximately 8,500 grams. In addition to the details shown in Fig. 1, the bottle was equipped with a heavy wire handle. From the standpoints of economy, efficiency and convenience, the respiration chamber gave satisfaction in every respect and was an improvement over the types of apparatus previously used in the work. At the present time several departments of the institution have adopted the pickle jar for use in various respiration experiments.

T. J. MANEY
P. L. HARDING
H. H. FLAGGE

IOWA STATE COLLEGE

SPECIAL ARTICLES

RELATION OF EXTERNAL ENVIRONMENT
TO COURSE OF A *B. ENTERITIDIS*
INFECTION IN MICE

In a previous communication¹ it was reported that if corresponding groups of rats are fed massive doses of cultures of *B. enteritidis* and kept in cold and warm rooms respectively the mortality is greater among those kept in the cold room. The results were not, however, conclusive, because rats are highly resistant to infection and infant rats and massive doses of bacteria had to be used.

The experiments are now being repeated with mice, and thus far the results indicate clearly that the external environment has a profound influence on the course of a *B. enteritidis* infection in mice. Animals kept in a cold room with a high relative humidity reacted quite differently from those kept in a warm room with a low relative humidity. The results varied also with the mode of infection.

Equal numbers of young mice of about the same weight (10 to 12 grams) were placed in battery jars. One set was kept in a cold room with a temperature range of 7° to 10° C., and a relative humidity of 70 to 80. The other was kept in a room incubator at a temperature of 28° C. and a relative humidity of 40 to 50. When the mice were infected intraperitoneally or subcutaneously the period between the day of infection and the first fatality was longer and

the number of survivors greater in the cold than in the warm room. When the infection was given per os the reverse was the case: the incubation period was shorter and the mortality greater in the cold than in the warm room. A summary is shown in tabular form.

In other words, the septicemic type of infection runs a more rapid course at a higher temperature, while the oral type is much more severe at the lower temperatures. These results may account for the seasonal character of typhoid-paratyphoid epidemics in man as well as in mice.² They may also provide an explanation for the lower case fatality in countries with a warm climate than in those with a temperate one. The investigation is being continued with a view to ascertaining the precise effects of temperature and humidity on the variation in host resistance recorded above.

I. J. KLIGLER

L. OLITZKI

HEBREW UNIVERSITY,
JERUSALEMBOTANICAL AND GEOLOGICAL EVIDENCE
FOR AN ANCIENT LAKE

THE presence, in early postglacial times, of a large lake in northwestern Wisconsin is indicated by the distribution of certain plants collected in that region during the summer of 1928. The first clue was given by *Juncus balticus*, var. *littoralis*. This rush, common along the shores of the Great Lakes, was first found in the interior of Wisconsin on the shore of Crystal Lake, in Dane County, near Prairie du Sac. Crystal Lake is described¹ as a relic of a larger glacial lake. The *Juncus* was next found on Lake Wingra, a few miles to the southeast, also a relic of a once larger body of water. In northwestern Wisconsin the plant was found last summer on a number of lakes (Fig. 1 shows the range in Wisconsin of *Juncus balticus*, var. *littoralis*). These lakes all have certain features in common, notably broad sandy shores and abandoned beaches several feet higher than the present water level. On each of such lakes, also, some or all of the following species, elsewhere unknown in that part of the state, were invariably found: *Panicum albemarlense*, *P. meridionale*, *Muhlenbergia uniflora*, *Stenophyllus capillaris*, *Ryncho-*

Dose (No. of bacteria) and method of infection	Temperature	No. of mice	Incub.* in days	No. of deaths	No. of survivors	Average duration of life from day of infection
3,000 ...	28° C.	8	4	5	3	
i.p. ...	9° C.	8	6	3	5	
30,000 ...	28° C.	9	2	8	1	5½
i.p. ...	9° C.	9	4	7	2	6
300,000 ...	28° C.	9	1	9	0	3
i.p. ...	9° C.	9	2	8	1	4½
3,000,000 ...	28° C.	10	0	10	0	1.9
i.p. ...	9° C.	10	0	9	1	2.4
3,000,000 ...	28° C.	7	2	5	2 (30 per cent.)	5.8
subcut. ...	9° C.	5	6	3	2 (40 per cent.)	7.7
200,000,000 ...	28° C.	10	...	0	10	
per os ...	9° C.	8	10	7	1	
1,000,000,000 ...	28° C.	8	9	2	6	
per os ...	9° C.	8	8	8	0	

* Equals days until first death appeared.

¹ I. J. Kligler, *Proc. Soc. Exp. Biol. and Med.*, 25: 20, 1927.

² I. J. Kligler, *Jour. of Hyg.*, 27: 14, 1927; Ida W. Pritchett, *Jour. Exp. Med.*, 41: 209, 1925; 43: 173, 1926.

¹ W. C. Alden, U. S. Geol. Sur. Prof. Paper 106: plate III, 1918.



spora capitellata, *Fimbristylis Frankii*, *Xyris torta* and *Polygonella articulata*. The presence of these plants in a definite circumscribed area, on the margins of a distinct type of lake whose shores indicate shrinking of their area, suggested the next point, that these lakes were once connected. The general distribution of these plants, already noted as inland extensions of the Atlantic coastal plain flora which migrated westward along the margin of the retreating Wisconsin ice sheet,² placed the time of this large lake as early postglacial.

One plant apparently was endemic on the shores of this ancient lake. *Bidens connata*, var. *pinnata*, originally described from near Minneapolis, Minnesota, occurs in Wisconsin only on these relic lakes (Fig. 2). The type region lies a few miles southwest of the Wisconsin stations; the presence of the plant there indicates that part of the old lake lay in Minnesota.

It is possible, in the region under consideration, to determine by a glance whether or not these plants will be found on the margin of any given lake. The relic character is at once indicated by the type of shore line. But similar lakes, separated by a ridge of high ground from the ancient lake bottom, have only such wide-spread forms as *Bidens frondosa*, *Eleocharis acicularis*, *Scirpus validus*, etc.

Certain other coastal plain plants, such as *Potamogeton bupleuroides*, *Eriocaulon septangulare* and *Bidens discoidea*, occur in northern Wisconsin with no apparent relation to the old lake bed.

During the past four field seasons parties of the Wisconsin Geological Survey have accumulated evidence leading to the conclusion that the greater part of what is commonly known as the Barrens of northwestern Wisconsin was a great interior arm of proglacial Lake Superior. The evidence may be summed up as follows:

(1) Shore-line processes have been active along the 1,150-foot contour (Fig. 3, heavy line), which surrounds the basin except on the west and the northeast.

(2) The basin thus enclosed is a rock-controlled structure. Its long axis is parallel to that of the main axis of folding of the Keweenaw or Lake Superior syncline. The northeast is closed structurally by an arch or crossfold (Fig. 3, cross-lined area) which separated the interior body from that part of proglacial Lake Superior which lay to the northeastward.

(3) Moraines within the basin (Fig. 3, solid black) show subaqueous erosion.

(4) Clays have accumulated in the lower basin (southwest) over an area at least forty-five miles long and twenty miles wide. These clays have given rise to two soil types, mapped by the State Soil Survey.

While the waters of the lake were receding, shore lines were extremely irregular, due to the rolling character of the lake bed. This fact may be seen by inspection of topographic maps of the area. With continued recession closed basins within these irregular shore lines became isolated lakes.

The independent lines of study in this region thus supplement each other. The botanical evidence points to the probability that the innumerable isolated lakes were at one time coalesced into a much larger body; the geological evidence indicates that the many small lakes are but present-day relics of a former greater body of water. The authors believe that similar corroboration of geological findings by botanical evidence may perhaps be discovered in connection with problems of this type throughout the glaciated middle west.

H. R. ALDRICH

Assistant State Geologist, Wisconsin

N. C. FASSETT

Department of Botany, University
of Wisconsin

MADISON, WISCONSIN

² D. C. Peattie, *Rhodora*, 24: 57-70, 80-88, 1922.